01.09- 10/10/94-00143

Revised: 4-21-94

FINAL

~~DRAFT FINAL~~

SITE INSPECTION

HEALTH AND SAFETY PLAN FOR SITES A, 12, 68, 75, 76, 84, AND 85 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0193

~~APRIL 21, 1994~~
OCTOBER 10, 1994

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under the:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared By:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

EXECUTIVE SUMMARY

The chemical hazards associated with the tasks at this site(s) are expected to include exposure to varying levels of volatile organic compounds (VOCs), pesticides, petroleum products, polychlorinated biphenyls (PCBs), and mustard agent.

The U.S. Army Technical Escort Unit (TEU) will be available on site to assist with the screening of samples for chemical agents. Section 2.0 describes the subcontractor's responsibilities.

The physical hazards include working around heavy equipment, drill rig and backhoe thermal stress and the limitations using personnel protective equipment. Each of this hazards is described in Section 3.0.

Section 5.0 describes the environmental monitoring requirements which consist of using an HNu with an 11.7 electron volt (eV) bulb and chemical agent monitoring equipment.

Due to the limited amount of information provided by previous investigations and record searches, assigned protection levels at this site(s) are conservative in nature. The level of personal protection assigned for work tasks and other operations will be Levels D, Modified Level D (D+), Level C and Level B. This information is provided in Section 6.0

Section 8.0 describes emergency procedures which includes Figure 8-1, showing the route to the nearest public and base hospital; along with first aid procedures, communication procedures, and other site concerns.

1.0 INTRODUCTION

This Site-Specific Health and Safety Plan (HASP) has been designed for site investigation work at Marine Corps Base (MCB), Camp Lejeune, Jacksonville, North Carolina, Sites A, 12, 68, 75, 76, 84, and 85.

1.1 Policy

It is the policy of Baker Environmental, Inc. (Baker) that all on-site hazardous waste management activities be performed in conformance with a Site-Specific HASP. The HASP is written based on the anticipated hazards and expected work conditions and applies to activities performed by both Baker and Baker's subcontractors. The HASP may be modified/updated with the approval of the Project Health and Safety Officer (PHSO) and Project Manager. Proper notification will be given to the Navy Technical Representative (NTR) when significant changes to the HASP are implemented.

This plan, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response).

1.2 References

The following publications have been referenced in the development and implementation of this HASP.

- American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 1993-1994.
- The Center for Labor Education and Research, Lori P. Andrews, P.E., Editor. Worker Protection During Hazardous Waste Remediation, Van Nostrand Reinhold, New York, New York. 1990.
- Lewis, Richard J., Sr. Hazardous Chemicals Desk Reference, 3rd Edition, Van Nostrand Reinhold, New York, New York. 1991.
- National Institute for Occupational Safety and Health/Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency (NIOSH/OSHA/USCG/EPA). Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.
- Occupational Safety and Health Administration. Federal Regulations. 29 CFR 1910 and 1926. 1993.
- U. S. Coast Guard. Policy for Response to Hazardous Chemical Releases. USCG Pollution Response COMDTINST-ML6465.30.
- U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH. NIOSH Pocket Guide to Chemical Hazards. June 1990.
- U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Emergency Response Division. Standard Operating Safety Guides. June 1992.
- U.S. Department of the Army. The Army Toxic Chemical Agent Safetv Program, Army Regulation 385-61.

- U.S. Department of the Army. Safety Regulations for Chemical Agents H, HD, HT, GB, and VX, AMC Regulation 385-131.

- Water and Research, Inc. Initial Assessment Study of Marine Corps Base Camp Lejeune, North Carolina. Prepared for Naval Energy and Environmental Support Activity (NEESA). April 1983.

1.3 Pre-Entry Requirements

During the site mobilization the Site Health and Safety Officer (SHSO) will perform a reconnaissance of each site (work areas) as identified in the Work Plan, establish or confirm emergency points of contact and procedures, and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with site personnel (as identified in Section 2.0) to discuss data obtained from the previous site reconnaissance, provisions outlined in this HASP, and appropriate safety and health related procedures/protocols.

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES

The following personnel are designated to carry out the stated job functions for both on- and off site activities. (Note: One person may carry out more than one job function, and personnel identified are subject to change.). The responsibilities that correspond with each job function are outlined below.

PROJECT MANAGER: Mr. Raymond Wattras

The project manager is responsible for assuring that all activities are conducted in accordance with the HASP. The Project Manager has the authority to suspend field activities if employees are in danger of injury or exposure to harmful agents. In addition, the Project Manager is responsible for:

- Assisting the PHSO in Site-Specific HASP development for all phases of the project.
- Designating a Site Health and Safety Officer and other site personnel who will assure compliance with the HASP.
- Reviewing and approving the information presented in this HASP.

PROJECT HEALTH AND SAFETY OFFICER (PHSO): Mr. Ronald Krivan, CSP

The PHSO is responsible for general development of the HASP and will be the primary contact for inquiries as to the contents of the HASP. The PHSO will be consulted before changes to the HASP can be approved or implemented. The PHSO is responsible for:

- Coordinating the review, evaluation, and approval of the HASP.
- Developing amendments to the HASP, when applicable.
- Resolving issues that arise in the field with respect to interpretation or implementation of the HASP.
- Monitoring the field program through a regular review of field health and safety records, on-site activity audits, or a combination of both.
- Determining that all Baker personnel have received the required training and medical surveillance prior to entry onto the site.

SITE MANAGER: (To be Provided in Final HASP Submission)

The Site Manager is responsible for assuring that all day-to-day activities are conducted in accordance with the HASP. The Site Manager has the immediate authority to suspend field activities if employees are subjected to a situation that can be immediately dangerous to life or health. The Site Manager's responsibilities include:

- Assuring that the appropriate health and safety equipment and PPE has arrived on site and that it is properly maintained.
- Coordinating overall site access and security measures, including documenting all personnel arriving/departing the site (by name, company and time).

- Approving all on site activities, and coordinating site safety and health issues with the SHSO.

- Assisting the SHSO in coordinating emergency procedures with the Naval Activity, emergency medical responders, etc., prior to or during site mobilization activities.

- Assuring compliance with site sanitation procedures and site precautions.

- Coordinating activities with Baker and subcontractor personnel.

- Overseeing the decontamination of field sampling equipment.

- Serving as the backup/alternate Emergency Coordinator.

- Assuming the responsibilities as indicated under "Field Team Leader," in his/her absence.

SITE HEALTH AND SAFETY OFFICER: (To be Provided in Final HASP Submission)

The SHSO is responsible for site implementation of the HASP. The SHSO also has the immediate authority to suspend field activities if the health or safety of site personnel is endangered; to audit the subcontractor training, fit testing, and medical surveillance records to verify compliance; and, maintaining these records at the Baker Command Post. The SHSO is responsible for:

- Coordinating the pre-entry briefing and subsequent briefings.
- Assuring that monitoring equipment is properly calibrated and operated.
- Assure compliance with the Standard Operating Procedures (SOPs) in Attachment A.
- Inform personnel of the Material Safety Data Sheets (MSDSs) located in Attachment B and emergency procedures for exposure to hazardous materials/waste presented in Attachment C.
- Managing health and safety equipment, including instruments, respirators, PPE, etc., that is used in field activities.
- Confirming emergency response provisions (as necessary) in cooperation with Naval Activity Requirements, emergency medical care, etc., prior to or during site mobilization activities.
- Monitoring conditions during field activities to assure compliance with the HASP and evaluate the need for work procedure or PPE changes.
- Documenting, as necessary, pertinent information such as, accident investigation and reporting, safety inspections, a record of site conditions, personnel involved in field activities, and any other relevant health and safety issues
- Overseeing the decontamination of personnel and determine safe boundary procedures for activities requiring Level C or higher protection levels.
- Acting as the Emergency Coordinator and assuring the availability of a communication network and deployment of the HASP and emergency equipment to field teams.

FIELD TEAM LEADER: (To be Provided in Final HASP Submission)

The Field Team Leader is responsible for:

- Safety issues relevant to the tasks under his/her direction.
- Determining safe boundary procedures for activities requiring Level D or D+ protection levels.
- Assuring that PPE is properly maintained.
- Complying with the conditions as outlined under Field Team Members.
- Assuming the responsibility as indicated under "Site Manager" in their absence.

FIELD TEAM MEMBERS: (To be Provided in Final HASP Submission)

The Field Team Members are responsible for:

- Familiarity with the HASP.
- Attending training sessions to review the HASP, and staying informed of additional safety and health information.
- Being alert to identified and unidentified hazards and reporting unidentified hazards to the SHSO and Site Manager.
- Offering suggestions, ideas, or recommendations that may improve or enhance site safety.
- Complying with the contents of the HASP.
- Conducting site activities in an orderly and appropriate manner.
- Reporting accidents/injuries, however minor, to the SHSO as soon as possible.

Subcontractor personnel are responsible for:

- Complying with the conditions as outlined under Field Team Members.
- Obtaining the appropriate training, fit testing, and medical surveillance requirements under 29 CFR 1910.120 and 1910.134 and providing this documentation to the Site Manager prior to or during site mobilization.
- Complying with the training and medical surveillance requirements as outlined in Sections 9.0 and 10.0, respectively, and providing his/her own PPE that meets or exceeds the level of protection as outlined in this HASP.

SUBCONTRACTOR COMPANIES:

Drilling Operations: (To be Determined per Baker's Basic Ordering Agreements)
Survey Operations: (To be Determined per Baker's Basic Ordering Agreements)
Geophysical Operations: (To be Determined per Baker's Basic Ordering Agreements)
UXO Clearance: (To be Determined per Baker's Basic Ordering Agreements)
Analytical Laboratory: (To be Determined per Baker's Basic Ordering Agreements)

NAVFACENGCOM REPRESENTATIVES:

Ms. Katherine Landman (NTR)	(804) 322-4818

ACTIVITY/BASE REPRESENTATIVES:

Mr. Neal Paul (CLEJ EMD)	(910) 451-5063

FEDERAL/STATE/LOCAL REPRESENTATIVES:

Ms. Gena Townsend (USEPA, Region IV)	(404) 347-3016
Mr. Patrick Walters (NCDEHNR)	(919) 733-2801

INDEPENDENT REPRESENTATIVE:
U. S. Army Technical Escort Unit

3.0 SITE CHARACTERIZATION

This section presents the site descriptions, work tasks at each site, and the associated hazard evaluation.

3.1 Site Background

This subsection presents site background information on the seven sites at MCB Camp Lejeune that are included in this HASP.

3.1.1 Site A - MCAS Officers Housing

Site Location and Setting

- Site is located along the bank of the New River, adjacent to the MCAS Officers Housing; high profile area.

- The area is due east approximately 375 feet from Longstaff Road at intersection of Trotter Street.

Site History

- Site history is unknown; was discovered during Round 2 sampling, 1986 (ESE). Waste was noted eroding out of a cut bank along the New River. Tentatively identified hospital wastes, including needles and vials of white powder (reportedly chlorine-based substance).

Previous Investigations

- Site Summary Report (1990)
  - Two shallow monitoring wells installed, 1986
  - Two rounds of sampling
    - December 1986: 2 groundwater wells. 1 surface water, 1 sediment
    - March 1987: 2 groundwater wells
  - Analyzed for free chlorine, oil and grease, VOAs
  - Findings:
    - 1986: sediment, 167 µg/g oil and grease
    - 1987: very low concentrations of oil and grease in groundwater

3.1.2 Site 12 - Explosive Ordnance Disposal (G4)

Site Location and Setting

- Area is less than two acres.

- Site located approximately two miles northeast of Sneads Ferry Road and Fire Tower M.

Site History

- Site is within an area where unserviceable or defective ordnance is disposed of by burning or exploding.

- Operation initiated in the early 1960s and continues today.

- Site discovered during operations (1992). A deep (approximately 8 feet bgs) explosion uncovered an oily sheen and petroleum odors were noted. Military personnel notified EMD.

- Suspected site (operational) related contaminants:
  - Ordnance - burned or exploded
  - Colored smokes
  - White phosphorus
  - Heavy metals

- Probable contaminants of concern:
  - Suspected petroleum/fuel discovered during demolition exercises at depths greater than 8 feet below ground surface.

3.1.3 Site 68 - Rifle Range Dump

Site Location and Setting

- Suspected burial area is less than five acres in size and is estimated to be approximately 10 feet deep with a total of approximately 100,000 cubic yards of material (Site Summary Report, 1990).

- Site located west of Range Road, about 2,000 feet west of the Rifle Range water treatment plant, about 800 feet east of Stone Creek.

Site History

- Operated from 1942 through 1972.

- Used as a disposal area; variety of wastes disposed including garbage, building debris, waste treatment sludge and approximately 2,000 gallons of waste solvents.

Previous Investigations

- Site Summary Report (1990)

  - Cited "major concern" for groundwater contamination; noted appearance of organic compounds identified in the potable supply wells (RR-45, 130 feet deep; RR-97, 200 feet deep), sampled in 1981 (results not provided).

  - Installed three shallow groundwater monitoring wells, 1984.

  - Two rounds of sampling
    - 1984: Three monitoring wells, two supply wells
    - November 1986: Two monitoring wells
    - Analyzed for VOAs
    - Findings: No compounds of concern detected in either round.

  - Following the two rounds of sampling, ESE proposed that previously detected VOAs were either a result of lab artifacts or minor quantities of degreasing solvents in the immediate vicinity of the wells.

3.1.4 Site 75 - MCAS Basketball Court

Site Location and Setting

- Burial area is approximately 90 feet by 70 feet.
- Site located north of Curtis Road to the vicinity of the MCAS Basketball Courts and is between the railroad tracks and the housing area.
- Rubber padded trucks used for disposal of 75 to 100 drums (IAS).

Site History

- Reportedly used for a one-time drum burial event in the 1950s.
- Possibly 8 feet of soil covering drums.
- Possibly as many as one hundred 55-gallon buried drums containing chloroacetophene (tear gas), chloropicrin (PS), chloroform, carbon tetrachloride, and benzene.
- Drum contents reportedly contained yellow and brown liquids.

Previous Investigations

- Site Summary Report (1990)
    - Installed three shallow groundwater monitoring wells, 1984
    - Two rounds of sampling
        - July 1984: Three monitoring wells, three supply wells
        - November 1984: Three shallow groundwater monitoring wells, three supply wells
        - Analyzed for VOAs, chloropicrin, tetrachlorodioxin
        - Findings: No compounds of concern detected during these rounds of sampling.
    - Geophysical survey conducted entailing electromagnetic conductance (EM) "metal-detection techniques" on a grid system.
    - No signs of buried metallic objects from geophysical survey.

3.1.5 Site 76 - MCAS Curtis Road

Site Location and Setting

- Area is approximately 1/4-acre.
- Site located adjacent to and north of Curtis Road and west of the terminus circle of Crawford Street.

Site History

- Reportedly used as a drum disposal area on two occasions in 1949.

- From twenty-five to seventy-five 55-gallon buried drums containing chloroacetophene (tear gas), chloropicrin (PS), chloroform, carbon tetrachloride, and benzene.

- Site and suspected contamination similar in nature to Site 75.

Previous Investigations

- Site Summary Report (1990)

    - Installed two shallow groundwater monitoring wells, 1984

    - Two rounds of sampling
        - July and November 1984: Two wells
        - Analyzed for VOAs, chloropicrin, tetrachlorodioxin
        - Findings: No compounds of concern detected during these rounds of sampling.

    - Geophysical survey conducted entailing electromagnetic conductance (EM) "metal-detection techniques" on a grid system.

    - No signs of buried metallic objects from geophysical survey.

3.1.6 Site 84 - Building 45 Area

Site Location and Setting

- Area is approximately less than 1/2-acre.

- Site is located approximately 200 yards south of Highway 24 at the main side of the base, near the main gate entrance to MCB Camp Lejeune.

Site History

- Site is a former electric substation where transformers were used and possibly stored.

- One (1) transformer was discovered during UST investigation by O'Brien and Gere (June 1992).

- Additional transformers (less than 20) were removed from pond adjacent to MW-13 and MW-14.

Previous Investigations

- Site Assessment, Tank S781, Midway Park, Marine Corps Base, Camp Lejeune. O'Brien and Gere. May 1992.

- Verbal information from Mr. Tom Morris, MCB Camp Lejeune

    - Transformer contents and surrounding soil sampled (three samples) for PCBs

    - Transformers retrieved from pond were not sampled for PCBs.

    - Findings:
        - Transformer content exhibited high PCB concentrations
        - Soil exhibited low level PCB concentrations

3.1.7 Site 85 - Camp Johnson Battery Dump

Site Location and Setting

- Area is approximately less than 1/2-acre.
- Site is located in a wooded area behind the vehicle training area at Camp Johnson.

Site History

- Site used during the 1950s.
- Discovered during 1992 road grading activities.
- Several decomposed batteries were identified and thought to be from the Korean War era. In addition, air purifying canisters were once identified at the site.

Previous Investigations

None

3.2 Site Work Plans

The Work Plan (detailing the tasks to be performed at each site), the Sampling and Analysis Plan (SAP), and Quality Assurance Project Plan (QAPP) are bound as separate documents, and accompany the Health and Safety Plan. A summary of site work tasks include:

- Hand excavation (Site A)
- Well installation (Sites 12, 68, 84, and 85)
- Groundwater sampling (Sites A, 12, 68, 75, 76, 84, and 85)
- Test pit excavation (Site A)
- Soil sampling (Sites A, 12, 68, 75, 84, and 85)
- Geophysics (Sites 75 and 76)
- Soil boring (Sites 12, 68, 84, and 85)
- Surface water/sediment samples (Sites 68 and 84)

3.3 Hazard Evaluation

This subsection presents the hazard evaluation of each task-specific hazard, chemical hazard, physical hazard, and environmental hazard.

3.3.1 Task-Specific Hazards

The pre-entry briefing and subsequent safety meetings will serve to address the hazards particular to the site, (such as sloping ground, uneven terrain, etc.) that were not apparent/known when the HASP was written. As each of these hazards are identified, the SHSO will add them to the HASP in the field along with the date of modification.

Listed below are summaries for the hazards associated with each of the site tasks. Levels of protection were selected based on this task-specific hazard identification, information obtained from previous investigations/site visits, and previous experience with similar site investigations/activities. Additionally, site personnel are expected to follow "safe" work practices as described in this HASP. The TEU will be on hand at Sites A, 75, and 76 to screen samples for chemical agents.

Sediment/Surface Water Sampling - Sites 68 and 84

Chemical

- Potential for contaminated material to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand to mouth contact.
- Inhalation of volatile constituents within the sediments or surface water.
- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain from boring with hand auger.
- Sampling operations that occur from boats. These operations must comply with Baker's Safety SOP for Safe Boat Operations.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and potentially hostile animal life.

Geophysical Investigation - Sites 75 and 76

Chemical

- Skin contact with potentially contaminated soils.
- Ingestion of contaminated material from hand to mouth contact.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation
- Interaction with native and potentially hostile animal life.

Soil Sampling - Sites A, 12, 68, 75, 84, and 85

Chemical

- Skin contact with potentially contaminated soils.
- Ingestion of hazardous materials from hand to mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Potential contact with unexploded ordnance (UXO).
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and potentially hostile animal life.
- Muscle strain from boring with hand auger.

Monitoring Well Installation - Sites 12, 68, 84, and 85

Chemical

- Potentially-contaminated mud, etc. in eyes and on skin.
- Contact with potentially contaminated material.
- Ingestion of hazardous materials from hand to mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Potential contact with unexploded ordnance (UXO).
- Heavy objects landing on foot/toe or head.
- Elevated noise levels from heavy equipment operation.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Overhead hazards from drill rig operations.
- Interaction with native and potentially hostile animal life.
- Contact with underground utility lines.
- Lifting hazards (muscle strain).

Monitoring Well Development - Sites 12, 68, 84, and 85

Chemical

- Potentially-contaminated groundwater, etc., in eyes and on skin.
- Ingestion of hazardous materials from hand to mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Potential contact with unexploded ordnance (UXO).
- Slips/trips/falls - sloped, uneven terrain.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and potentially hostile animal life.

Groundwater Sampling - Sites A, 12, 68, 75, 76, 84, and 85

Chemical

- Skin contact with potentially contaminated water.
- Eye contact from splashing water.
- Ingestion of hazardous materials from hand to mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants emitting from the well opening.

Physical/Environmental

- Potential contact with unexploded ordnance (UXO).
- Skin irritation from contact with insects and vegetation.
- Lifting hazards (muscle strain, etc.) while bailing well.
- Cuts from using knives to cut bailer rope.
- Slips/trips/falls - sloped, uneven terrain.
- Interaction with native and potentially hostile animal life.

Hand Excavation - Site A

Chemical

- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Ingestion of hazardous materials from hand to mouth contact.
- Contact with potentially contaminated material.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and potentially hostile animal life.

Soil Boring-Sampling - Sites 12, 68, 84, and 85

Chemical

- Potentially-contaminated mud, etc., in eyes or on skin.
- Skin contact with potentially contaminated soil.
- Ingestion of potentially contaminated soils from hand to mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.

Physical/Environmental

- Potential contact with unexploded ordnance (UXO).
- Elevated noise levels from heavy equipment operations.
- Lifting hazards (muscle strain).
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities.
- Interaction with native and potentially hostile animal life.
- Heavy objects landing on foot/toe or head.
- Strips/trips/falls from sloped, uneven terrain.

Test Pit/Trenching - Site A

Chemical

- Skin contact with contaminated soil.
- Ingestion of contaminated soils from hand to mouth contact.
- Inhalation of volatile contaminants or volatile fraction of semivolatile contaminants.
- Skin contact with potentially toxic-"pure product" contaminants.

Physical/Environmental

- Overhead hazards.
- Skin irritation from contact with insects and vegetation.
- Contact with underground utilities.
- High grade slopes that may require shoring according to OSHA Standards.
- Interaction with native and potentially hostile animal life.
- Explosion from contact with explosive/ignitable materials.
- Elevated noise levels from heavy equipment operation.

3.3.2 Chemical Hazards

Exposure to hazardous chemicals can occur through various pathways into the body. These pathways include:

- Inhalation of vapors, gases, or particulates.
- Ingestion of contaminated particulates from hand-to-mouth contact.
- Dermal and eye contact from direct, unprotected contact.
- Absorption through the eye or skin from exposure to concentrations in the air.

The chemical exposure potential for personnel working at Sites A, 12, 68, 75, 76, 84, and 85 is expected to relate directly to the chemicals detected during preliminary sampling investigations and reported past disposal practices. Therefore, Tables 3-1 through 3-7 identify the chemical/physical properties and exposure symptoms/routes of entry, respectively, for the chemicals detected during preliminary sampling investigations that present the greatest hazard.

The following information pertains to blister agents and tear agents. Additional information regarding these or other chemicals listed on Tables 3-1 through 3-7 can be reviewed on the Material Safety Data Sheets (MSDSs) in Appendix B. The data presented in the MSDSs reflects the chemical and toxicological properties of the specific compound in a pure, non-diluted state. As such, when these compounds are detected in environmental media (i..e, soil, groundwater, sediment, and surface water), the hazards are anticipated to be substantially less than those associated with exposure to "pure" compounds. The data presented in the MSDSs will, therefore, be utilized as reference information when questions arise as to a constituents' chemical and toxicological property or measures for emergency response.

Note: Procedures to follow in the event of a chemical exposure, are included as Attachment C.

Blister Agents

All of the Blister Agents are persistent. Blister agents damage any tissue that they contact. They affect the eyes and lungs and blister the skin. They damage the respiratory tract when inhaled and cause vomiting and diarrhea when absorbed.

Mustard - H, HS or HD (Sulfur Mustards)

Levinstein mustard (H) -H is the original mustard (gas) of World War I vintage. During World War II, HS, signifying Sulfur Mustard, was also used as opposed to HN or Nitrogen Mustard which had been stockpiled by Germany. H contains about 30% sulfur impurities, which give it a pronounced odor similar to garlic or horseradish. The impurities lessen the effectiveness of H and lower its freezing point 2-5°F. Other properties of H are essentially the same as those for distilled mustard, which is discussed next.

Distilled Mustard (HD) - HD is a purified form of H and is a colorless to amber colored liquid with a garlic-like odor. The effects of HD are usually delayed 4-6 hours, but 24-hour latency periods have been observed. The higher the concentration, the shorter the interval of time from exposure to the first symptoms (i.e., latency period) Mustard acts first as a cell irritant and finally as a cell poison on all tissue surfaces contacted. Early symptoms include inflammation of the eyes; inflammation of the nose, throat, trachea, bronchi, and lung tissue; and redness of the skin; blistering or ulceration may follow. Effects may include a more "at ease" attitude, vomiting, and fever, beginning about the same time as skin reddening.

TABLE 3-1

TOXICOLOGICAL PROPERTIES OF CHEMICALS
SITE A - MCAS Officers Housing

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
Calcium hypochlorite	1 0 2	-	No	No	None established	-	-	-	-
MUSTARD GAS:									
H	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-
HD	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-
HS	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.

(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).

(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.

(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.

(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.

(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.

(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.

(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.

(i) IDLH - Immediately Dangerous to Life and Health.

(j) Ionization Potential - expressed in electron volts (eV).

Note that oil and grease have been identified on this site. This is not expected to be a concern because of the protection levels established for the other chemicals.

TABLE 3-2

TOXICOLOGICAL PROPERTIES OF CHEMICALS
SITE 12 - Explosive Ordnance Disposal

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
VOLATILES:									
Diesel Fuel	0 2 0	<1	No	No	5 mg/m^3 (mist)	10 mg/m^3 (mist)	-	-	<11.7
Fuel Oil No. 6	0 2 0	0.2 mm @ 21° C	No	No	-	-	-	-	<11.7
Gasoline	1 4 0	Not Listed	No	No	300 ppm	500 pm	-	-	<11.7
Kerosene	0 2 0	5	No	No	-	-	-	-	<11.7

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.

(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).

(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.

(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.

(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.

(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.

(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.

(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.

(i) IDLH - Immediately Dangerous to Life and Health.

(j) Ionization Potential - expressed in electron volts (eV).

TABLE 3-3

TOXICOLOGICAL PROPERTIES OF CHEMICALS
Site 68 - Rifle Range Dump

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
VOLATILES:									
Acetone	1 3 0	180	No	No	750 ppm	1,000 ppm	-	20,000 ppm	9.69
Benzene	2 3 0	75	No	Yes	1 ppm	5 ppm	-	3,000 ppm	9.25
Chlorobenzene	2 3 0	8.8	No	No	75 ppm	-	-	2,400 ppm	9.07
Methylene Chloride	2 1 0	350	No	Yes	500 ppm	-	1,000 ppm	5,000 ppm	11.32
1,1,2,2-Tetrachloroethane	2 0 0	6 Torrs @ 25° C	Yes	Yes	1 ppm	-	-	150 ppm	11.10
Trichloroethylene	2 2 0	58	No	Yes	50 ppm	200 ppm	-	1000 ppm	9.45

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.

(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).

(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.

(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.

(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.

(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.

(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.

(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.

(i) IDLH - Immediately Dangerous to Life and Health.

(j) Ionization Potential - expressed in electron volts (eV).

TABLE 3-4

TOXICOLOGICAL PROPERTIES OF CHEMICALS
Site 75 - MCAS Basketball Court

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
Benzene	2 3 0	75	No	Yes	1 ppm	5 ppm	-	3,000 ppm	9.25
Chloroacetophene (tear gas)	2 1 0	0.01	No	No	0.05 ppm	-	-	100 mg/m^3	9.44
Chloroform	2 0 0	160	No	Yes	2 ppm	-	-	1,000 ppm	11.42
Chloropicrin (PS)	4 0 3	20	No	No	0.1 ppm	-	-	4 ppm	-
Carbon Tetrachloride	3 0 0	91	Yes	Yes	5 ppm	10 ppm	25 ppm	300 ppm	11.47
MUSTARD GAS: H	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-
HD	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-
HS	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.

(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).

(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.

(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.

(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.

(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.

(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.

(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.

(i) IDLH - Immediately Dangerous to Life and Health.

(j) Ionization Potential - expressed in electron volts (eV).

TABLE 3-5

TOXICOLOGICAL PROPERTIES OF CHEMICALS
Site 76 - MCAS Curtis Road

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
Benzene	2 3 0	75	No	Yes	1 ppm	5 ppm	-	3,000 ppm	9.25
Chloroacetophene (tear gas)	2 1 0	0.01	No	No	0.05 ppm	-	-	100 mg/m^3	9.44
Chloroform	2 0 0	160	No	Yes	2 ppm	-	-	1,000 ppm	11.42
Chloropicrin (PS)	4 0 3	20	No	No	0.1 ppm	-	-	4 ppm	-
Carbon Tetrachloride	3 0 0	91	Yes	Yes	5 ppm	10 ppm	25 ppm	300 ppm	11.47
MUSTARD:									
H	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-
HD	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-
HS	4 1 1	0.072	Yes	Yes	0.003 mg/m^3	-	-	-	-

Notes:
(a) Chemical compound of potential concern obtained from previous investigation.
(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).
(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.
(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.
(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.
(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.
(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.
(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.
(i) IDLH - Immediately Dangerous to Life and Health.
(j) Ionization Potential - expressed in electron volts (eV).

TABLE 3-6

TOXICOLOGICAL PROPERTIES OF CHEMICALS
Site 84 - Building 45 Area

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
PCB	2 1 0	0.005 mm @ 100° C	No	Yes	0.5 mg/m^3	-	-	-	-

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.

(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).

(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.

(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.

(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.

(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.

(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.

(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.

(i) IDLH - Immediately Dangerous to Life and Health.

(j) Ionization Potential - expressed in electron volts (eV).

TABLE 3-7

TOXICOLOGICAL PROPERTIES OF CHEMICALS
SITE 85 - Camp Johnson Battery Dump

CHEMICAL COMPOUND(a)	HAZARD RATING(b) H F R	VOL.(c)	SKIN ABSORP.(d)	CARC.(e)	TWA(f)	STEL(g)	C(h)	IDLH(i)	IP(j)
METALS:									
Cadmium	3 1 0	NA	No	Yes	0.05 mg/m^3	-	-	-	NA
Chromium	NA	NA	No	Yes	0.5 mg/m^3	-	-	-	NA
Lead	NA	NA	No	Yes	0.05 mg/m^3	-	-	700 mg/m^3	NA

Notes:

(a) Chemical compound of potential concern obtained from previous investigation.

(b) Hazard Rating - based upon Health (H), Fire (F), or Reactivity (R) hazard from NFPA 704 Standard Rating System (0 = no hazard, 4 = high hazard).

(c) Volatility Rating - based upon vapor pressure in mm Hg at 68° F, 20° C.

(d) Skin Absorption - "Yes" indicates potential exposure through skin and mucous membranes, either by airborne or, more particularly, by direct contact - ACGIH 1993-1994.

(e) Carcinogen - "Yes" indicates a compound is a confirmed or suspect human carcinogen by the IARC, NIOSH, NTP, EPA or ACGIH.

(f) TWA - Time Weighted Average from the 1993-1994 TLV - Threshold Limit Value of the ACGIH or OSHA Permissible Exposure Limits (PEL), whichever is lower.

(g) Short Term Exposure Limit - "STEL" denotes a 15 minute time weighted average which may not be exceeded - ACGIH 1993-1994.

(h) Ceiling Limit - denotes the ceiling concentration that cannot be exceeded at any time.

(i) IDLH - Immediately Dangerous to Life and Health.

(j) Ionization Potential - expressed in electron volts (eV).

Nitrogen Mustard - HN-1 or HN-3

HN-1 is an oily, colorless to pale yellow with a fishy or musty odor. HN-3 is an oily liquid with no odor. HN-1/HN-3 irritate the eyes in dosages which do not significantly damage the skin or respiratory tract, insofar as single exposures are concerned.. Eye irritation appears in a shorter time than that from HD. Mild vapor exposure may result in no skin lesions. After severe vapor or liquid exposure irritation, itching and reddening of the skin may occur. Later blisters may form on the affected areas. Effects on the respiratory tract include irritation of the nose and throat, hoarseness progressing to loss of voice, and persistent cough. Fever, labored respiration, and rales (abnormal sounds) may develop. Bronchial pneumonia may appear after the first 24 hours. Following ingestion or systemic absorption, the agent causes inhibition of cell division, resulting in depression of the blood-forming mechanism and injury to other tissues. Severe diarrhea, which may be accompanied by bleeding, occurs.

Lewisite - L (Arsenical)

The arsenical vesicants are a group of blister agents in which arsenic is the central element.

Lewisite (L) is a liquid with an odor similar to geraniums and very little odor when pure. L warns of its presence by irritating the eyes and skin and has a rapid rate of action. Liquid L causes immediate burning sensation in the eyes and permanent loss of sight if not decontaminated within one minute with large amounts of water. It has about the same blistering action on the skin as does the Mustard (HD), even though the lethal dosage for L is much higher. Skin exposure to L produces an immediate and strong stinging sensation; reddening of the skin starts within 30 minutes. Blistering does not appear until after about 13 hours.

Tear Agent

Tear compounds cause a flow of tears and irritation of the skin. Because tear compounds produce only transient effects, they are widely used for training and riot control.

Chloroacetophene - CN

The physical state of Chloroacetophene (CN) is a solid powder. CN is described as having an odor similar to apple blossoms.

CN identifies the riot control agent popularly known as tear gas or mace. CN quickly irritates the eyes and upper respiratory passages. In higher concentrations it causes copious tearing; a tingling sensation, irritation, burning and pain of the nose and throat; and burning and itching on tender areas of the skin, especially areas wet by perspiration. High concentrations can cause blisters. The effects are similar to those of a sunburn and disappear in a few hours.

3.3.3 Physical Hazards

3.3.3.1 Confined Space Entry

Confined space entry will not occur at this site(s), therefore, confined space entry procedures will not be required.

3.3.3.2 Thermal Stress

Provisions for monitoring of heat stress and/or cold stress (both are included until mobilization date is known) are outlined in Attachment A - Baker Safety SOPs.

3.3.3.3 Noise

Elevated noise levels may be produced during drilling and other heavy equipment operations; therefore, hearing protection devices will be available. The SHSO is responsible for making this determination based upon past experience with the type of equipment in use, and the proximity of personnel to the equipment.

3.3.3.4 Explosion and Fire

In general, the following items present potential physical hazards and will be monitored closely:

- Explosion and fire resulting from:
  - Heavy equipment malfunction
  - Penetration into underground utility/service lines (gas, electric, fuel)
  - Ignition of trapped flammable vapors
  - Vehicular accidents
  - Puncturing of drums or containers during test pitting
  - Detonation of UXO (Site 12 only)

Provisions for monitoring for potential fire/explosive conditions may include the use of an oxygen/combustible gas meter (as indicated in Section 5.2) and the performance of utility checks prior to conducting intrusive activities. At Site 12, UXO clearance for sampling locations will be provided by a qualified subcontractor. As additional concerns are identified, provisions for making changes to the HASP will be presented by the SHSO, as needed.

3.3.3.5 Utilities

Underground utility clearance must be obtained before any intrusive activities are performed; this clearance will be provided by a base representative for this project. If underground utilities are identified in these areas, the ground above the utility lines are to be physically marked, such as, with spray paint or flags. Baker personnel are to notify the base representatives at least three days prior to soil intrusive activities to acquire a utility clearance. A minimum of a 24 inch tolerance zone must be used for underground utilities.

The generally accepted uniform color code for underground utilities is as follows:

- Red - Electric power lines, cables, conduit and lighting cables
- Yellow - Gas, oil, steam, petroleum, or gaseous materials
- Orange - Communication, alarm or signal lines, cables or conduit
- Blue - Water, irrigation, and slurry lines
- Green - Sewers and drain lines
- White - Proposed excavation

Energized overhead electric lines may present a risk of electrocution. OSHA standards require that equipment maintain certain distances from power lines. For lines 0 to 50 kilovolts (kV), the minimum distance is 10 feet. Lines carrying over 50 kV require that equipment maintain 10 feet, plus an additional 0.4 inch for each 1 kV over 50.

3.3.3.6 Heavy Equipment

One of the primary physical hazards on the site is associated with the use of heavy equipment, which includes the use of a drill rig. Only operators trained, qualified, and authorized will be permitted to operate the heavy equipment.

General hazards associated with the drill rig include moving parts, such as, the auger and cathead. Personnel must remain clear of moving parts and must avoid loose fitting clothing that can become entangled in the moving parts. Personnel working near a drill rig must be aware of the location and operation of the emergency shut off devices. Personnel are to stand clear of the drill rig immediately prior to starting the engine.

Noise from the operation of the heavy equipment will limit verbal warning abilities. Hand signals will be prearranged between operators and personnel working in and around heavy equipment. Backup alarms must operate properly on the heavy equipment.

The drilling subcontractor representatives are to provide any other cautions that need to be observed when working around this equipment during the HASP pre-entry briefing.

During backhoe operations, a "spotter" will be in place to direct the backhoe operator. Other personnel in the area, such as those conducting sampling, are to remain close together and in the line of sight of the operator. These personnel can proceed to the trenching area only when an "all clear" is given by the spotter and operator. Caution must be exercised in these work areas to avoid slips, trips, and falls. Personnel are not permitted to enter into any trenches. Samples will be collected from the soil pulled out in the bucket of the backhoe.

3.3.4 Environmental Hazards

3.3.4.1 Hazardous Flora

Incidence of contact by individuals to poisonous/thorny plants is high (especially during surface water and sediment sampling activities); therefore, bare skin should be covered (i.e., long pants and shirt, steel toe boots, leather or cotton gloves, safety glasses, and head protection) as much as practical when working in forested or densely vegetated areas. Personnel should avoid entering an area in the direct path of known poisonous flora (i.e., poison ivy/oak), a secondary route should be selected. Care should also be taken when walking in such areas as uneven terrain or vines may present a tripping hazard.

While attempting to cut into dense underbrush, hazards exist from the sharp machete and gas-powered weed cutter, therefore, care should be taken when using such devices. (Note: Hearing protection, steel toe boots, gloves, and safety glasses are required when using weed cutters.) All rashes and other injuries will be reported to the SHSO as soon as they are known.

3.3.4.2 Hazardous Fauna

All animal life must be treated with respect. Without proper training, personnel may not be able to differentiate between dangerous and nondangerous varieties. Therefore contact with surface water should be kept to a minimum and working in wet or swampy areas unprotected is not permitted.

Mosquitoes and gnats pose a nuisance and physical hazard to field personnel; they distract workers, leading to accidents, and pose a physical threat by transmitting live microorganisms. Avoiding the use of perfumes and scented deodorants and donning light colored clothing is preferable. The use of Avon's "Skin So Soft" or other insect repellent is encouraged and will be provided on the site.

There is a potential to come in contact with other dangerous insects; these include fire ants, chiggers, bees, wasps, hornets, mites, fleas, spiders, and ticks.*. All personnel should perform "checks" on each other periodically and at the end of the work shift, especially when working in grassy or forested areas. All insect bites must be reported to the SHSO.

Poisonous snakes such as the rattlesnake, copperhead, and cottonmouth (water moccasin), all known as pit vipers, are common to the United States. Snakes typically do not attack people but will bite when provoked, angered, or accidentally injured (as when stepped on). When encountering a snake, avoid quick/jerky motions, loud noises, and retreat slowly; do not provoke the snake. If bitten, follow procedures outlined in Section 8.7, Emergency Medical Treatment.

Prior to initiating site activities, each individual at the site shall be questioned by the Site Manager and/or SHSO as to any known sensitivities to the previously mentioned organisms or agents.

---

* *Site personnel have been provided with a copy of Baker's policy (per our medical consultant) regarding the signs and symptoms of exposure for Lyme Disease.*

4.0 SITE CONTROL

The following sections define measures and procedures for maintaining site control. Site control is an essential component in the implementation of the site health and safety program.

4.1 Site Access

- The Site Manager is designated to coordinate overall access and security on site. Perimeters for activities to be conducted at Sites A, 12, 68, 75, 76, 84, and 85 will be established according to the site boundary procedures identified in Section 4.3, local conditions, and Navy Activity requirements.
- Personnel will not be permitted within the Work Zone (Exclusion Zone) or Contamination Reduction Zone without proper authorization from the SHSO.
- All personnel arriving or departing the site will be documented in the field log.
- All activities on site must be cleared through the Site Manager and documented in the Field Log.
- The on-site Command Post will be established at the site trailer in Lot 203.
- Figures 4-1 through 4-7 identify the location of the sites under investigation.

4.2 Site Conditions

- The prevailing wind conditions are to be determined daily. This will be accomplished with the use of a wind direction indicator, such as a wind sock. The wind direction indicators are to be provided in areas readily visible to personnel in the area.

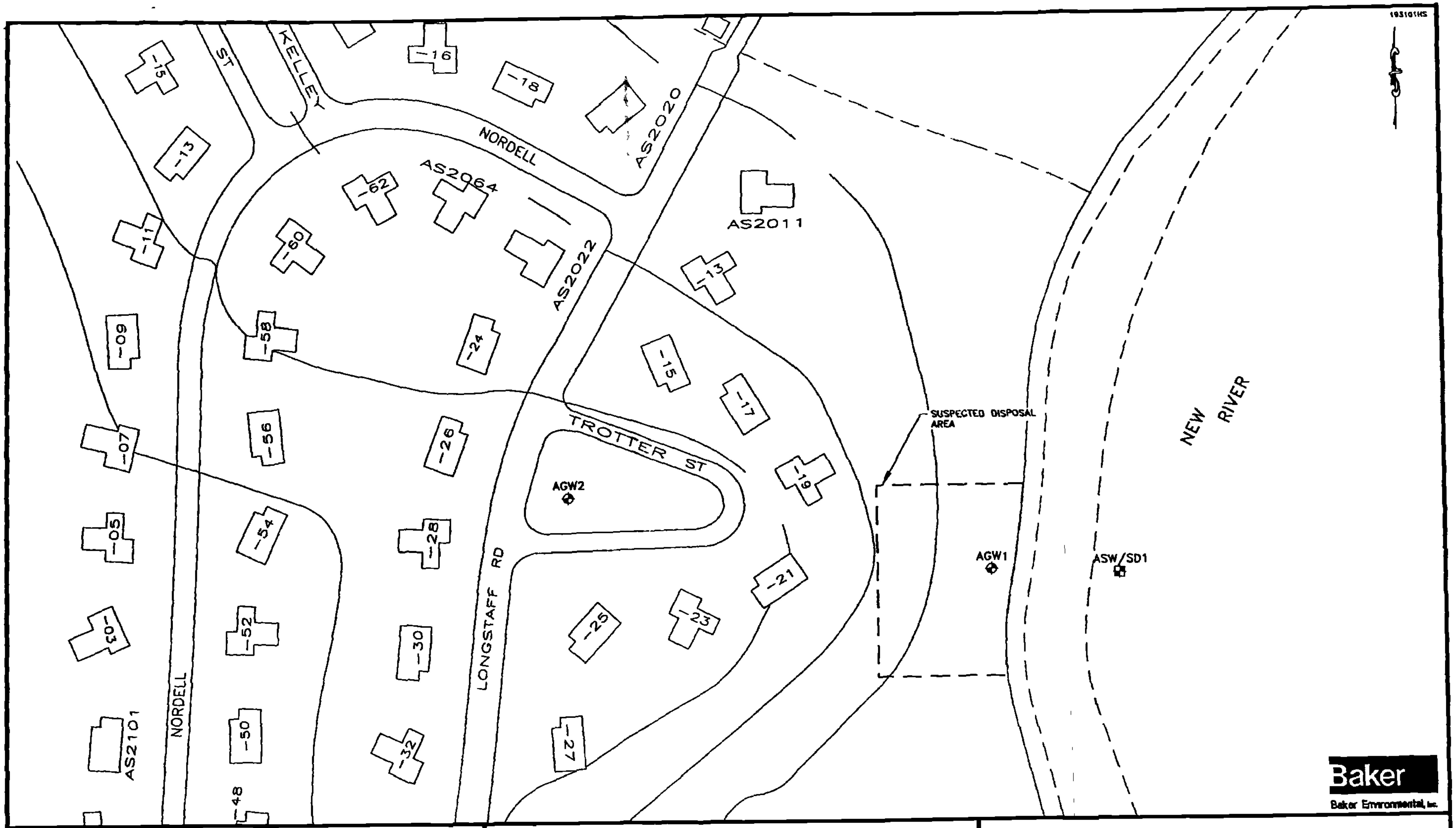
4.3 Work Zones

4.3.1 Level B and C Activities

Work Zones for activities conducted under Level C or higher protection levels shall be established utilizing control boundaries between the Work Zone, the Contamination Reduction Zone (CRZ), and the Support Zone (Clean Zone). These boundaries shall be defined as follows:

- Work Zone - The area where the primary site investigation activity occurs.
- Hotline - The boundary between the Work Zone and CRZ.
- CRZ - The area between the Work Zone and the Support Zone (located upwind of the site investigative activities).
- Contamination Control Line - The boundary between the CRZ and the Support Zone.
- Support Zone - The outermost area next to the CRZ and upwind of the site investigative activities.

These boundaries will be demarcated using colored boundary tape, cones, or equivalent for the Hotline or the Decontamination Corridor of the CRZ, and/or barriers for the Contamination Control Line such as posted signs and/or barricades.



LEGEND

AGW1 – EXISTING SHALLOW MONITORING WELL

ASW/SD1 – PREVIOUS SURFACE WATER/SEDIMENT SAMPLING LOCATION

SOURCE. LANTDIV. FEB. 1992

100 0 50 100 200

1 inch = 100 ft.

FIGURE 4–1
SITE MAP AND PREVIOUS SAMPLING LOCATIONS
SITE A
MCAS OFFICER's HOUSING AREA
SITE INSPECTION CTO–0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

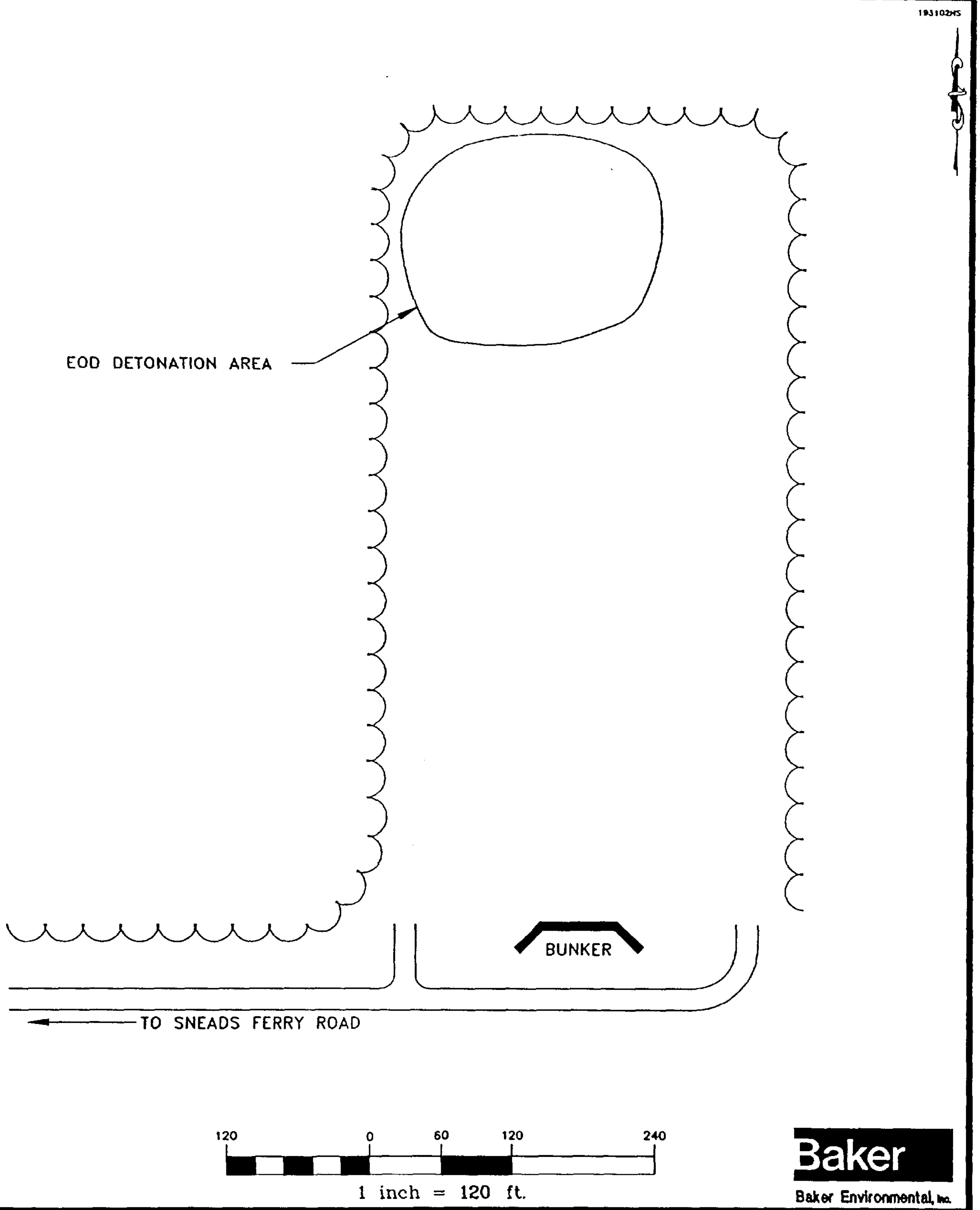
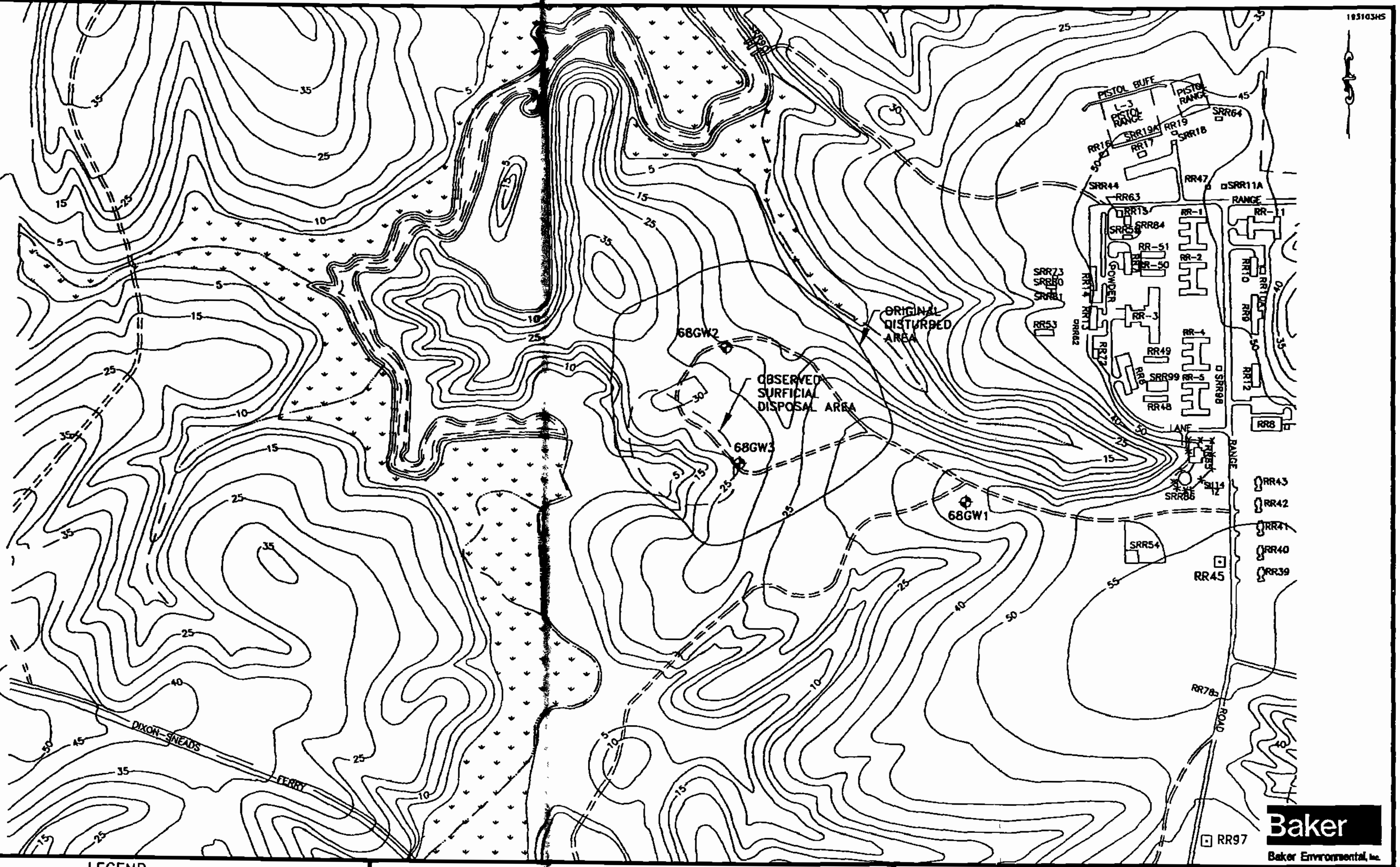


FIGURE 4-2
SITE MAP
SITE 12
EXPLOSIVE ORDNANCE DISPOSAL AREA
SITE INSPECTION CTO-0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



Baker

Baker Environmental, Inc.

LEGEND

68GW1 ⊕ – EXISTING MONITROING WELL LOCATION

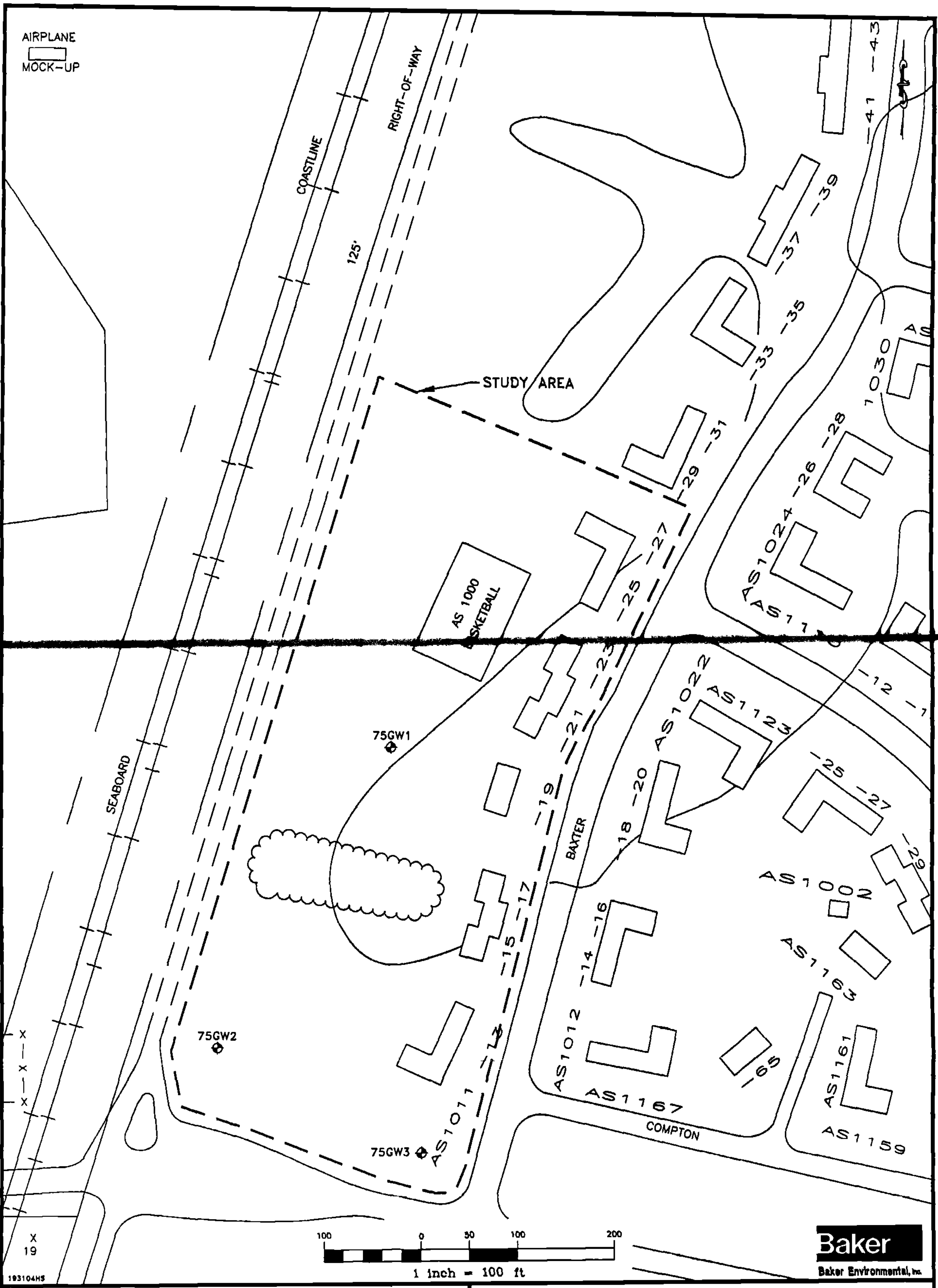
RR45 ⊡ – POTABLE WATER SUPPLY WELL

SOURCE. LANTDIV, FEB. 1992

500 0 250 500 1000

1 inch = 500 ft.

FIGURE 4-3
SITE MAP AND PREVIOUS SAMPLING LOCATIONS
SITE 68
RIFLE RANGE DUMP
SITE INSPECTION CTO-0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



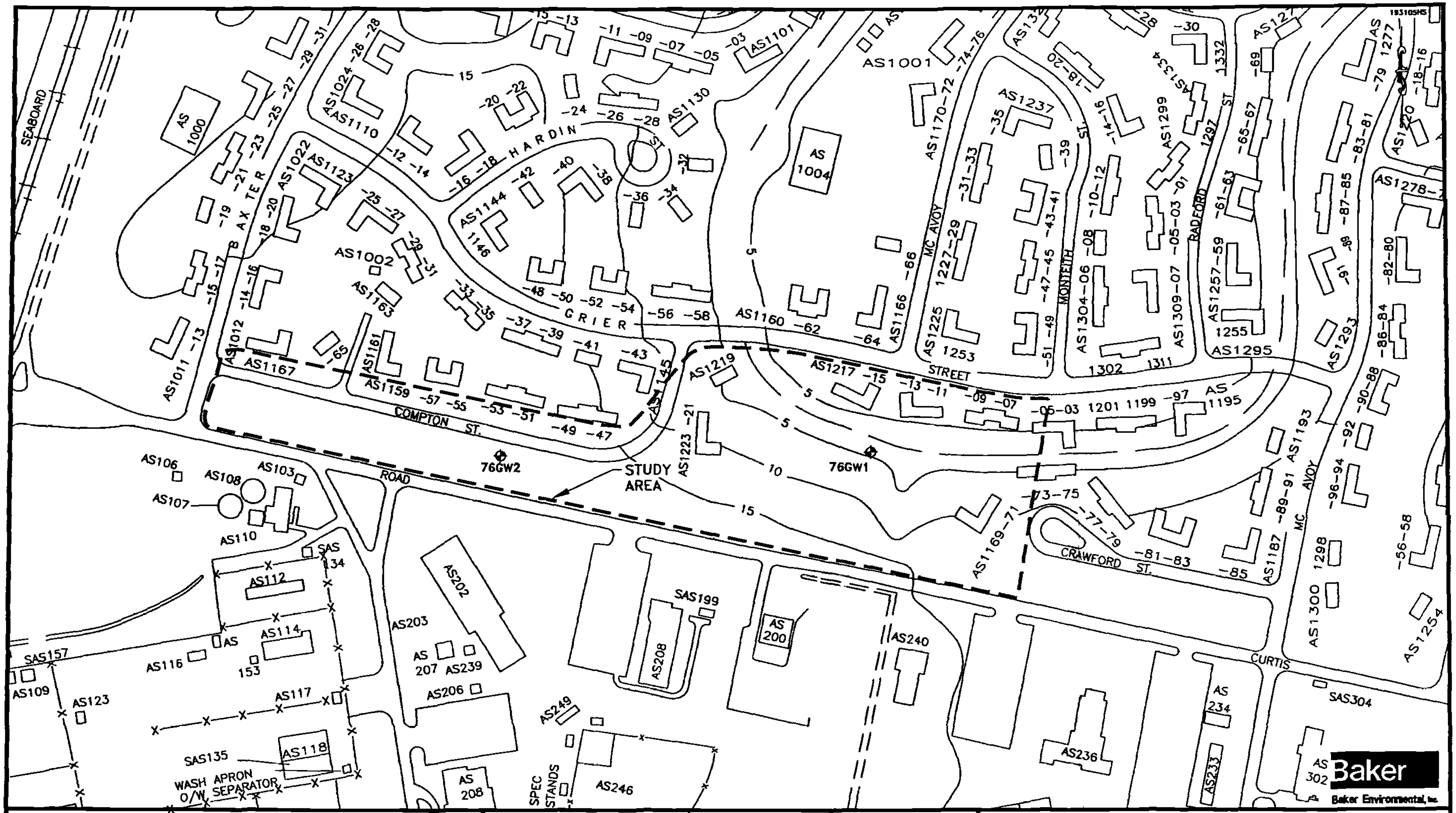
LEGEND

75GW1 ⊕ - EXISTING SHALLOW MONITORING WELL

SOURCE LANTDIV, FEB 1992

FIGURE 4-4
SITE MAP AND PREVIOUS SAMPLING LOCATIONS
SITE 75
MCAS BASKETBALL COURT
SITE INSPECTION CTO-0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00143B032



LEGEND

76GW1 ⊕ – EXISTING SHALLOW MONITORING WELL

SOURCE LANTDIV, FEB. 1992

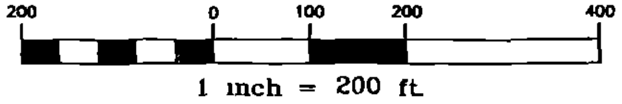
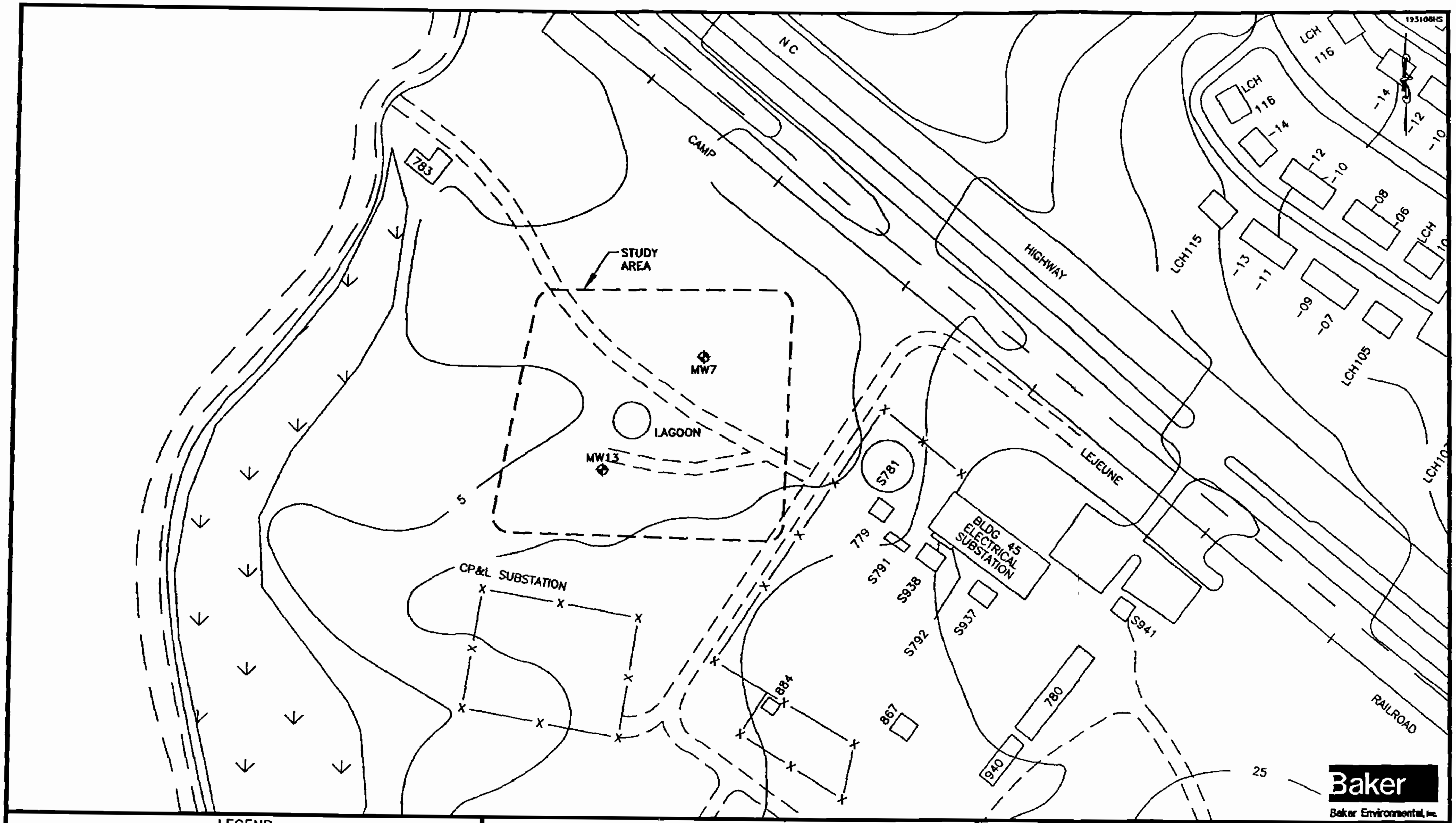


FIGURE 4-5
SITE MAP AND PREVIOUS SAMPLING LOCATIONS
SITE 76
MCAS CURTIS ROAD
SITE INSPECTION CTO-0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00143 B04Z



LEGEND

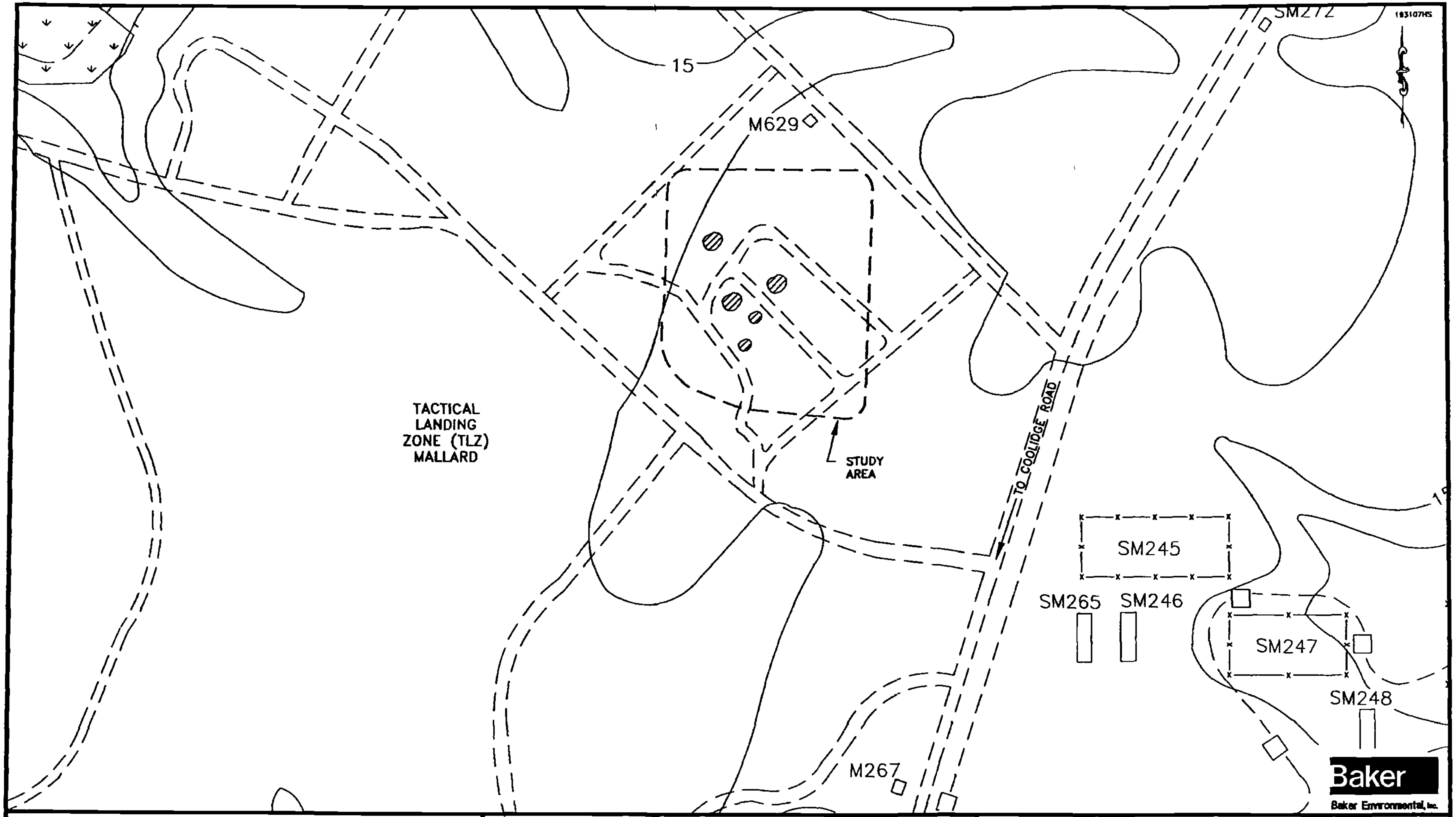
MW7 ⊕ – EXISTING SHALLOW MONITORING WELL

SOURCE: LANTDIV, FEB. 1992

120 0 60 120 240

1 inch = 120 ft.

FIGURE 4-6
SITE MAP
SITE 84
BUILDING 45 AREA
SITE INSPECTION CTO-0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

▨ – BATTERY DISPOSAL AREA

SOURCE: LANTDIV, FEB 1992

200 0 100 200 400

1 inch = 200 ft.

FIGURE 4-7
SITE MAP
SITE 85
CAMP JOHNSON BATTERY DUMP
SITE INSPECTION CTO-0193
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00143 B06Z

Refer to Figure 4-8 for a "General Contamination Reduction Zone Layout." Exact locations of the demarcated zones will be field determined by the SHSO during site mobilization.

4.3.2 Level D and D+ Activities

4.3.2.1 Populated Areas

In populated areas, Work Zones for activities conducted under Level D or D+ protection levels shall be established in such a manner as to preclude unauthorized personnel from entering the investigative area. A boundary will be established to separate the Work Zone from the Clean Zone using available materials such as, the Baker Field Vehicle, natural boundaries (buildings, structures, fences), or signs/placards, boundary tape, cones, barricades, etc.

4.3.2.2 Unpopulated/Secluded Areas

In unpopulated or secluded areas, the aforementioned materials may not be used due to the exclusive nature of the site, the short duration of the activity, and the low risk to outside populations. The SHSO and/or Field Team Leader is responsible for making this determination.

4.4 "Buddy System"

All site activities that involve hazards and/or the potential for contact with hazardous materials will be performed by a work team of no fewer than two people (Buddy System). For potential "high-hazard" activities, a third person located in the Support Zone will serve as an observer or to assist with rescue, if needed.

4.5 Safe Work Practices

Routine safe work practices may consist of:

- Conducting operations in a manner to reduce exposure of personnel and equipment.
- Implementing appropriate decontamination procedures.
- Conducting sampling activities from an upwind location.
- Adherence to applicable safety regulations in OSHA Standards 29CFR 1910 and 1926.
- Setting up barriers to exclude unauthorized personnel from contaminated areas.
- Minimizing the number of personnel and equipment at the site (s).
- Establishing work zones within the site.
- Establishing control points for ingress to and egress from work zones.

4.5.1 Heavy Equipment

The following safe work practices will be adhered to during heavy equipment operations.

- Hard hats will be worn at when working in a work zone with heavy equipment.

- Heavy equipment requiring an operator will not be permitted to run unattended.

- Heavy equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.

- Heavy equipment will be shut down and positive means taken to prevent its operation while repairs or fueling are being performed.

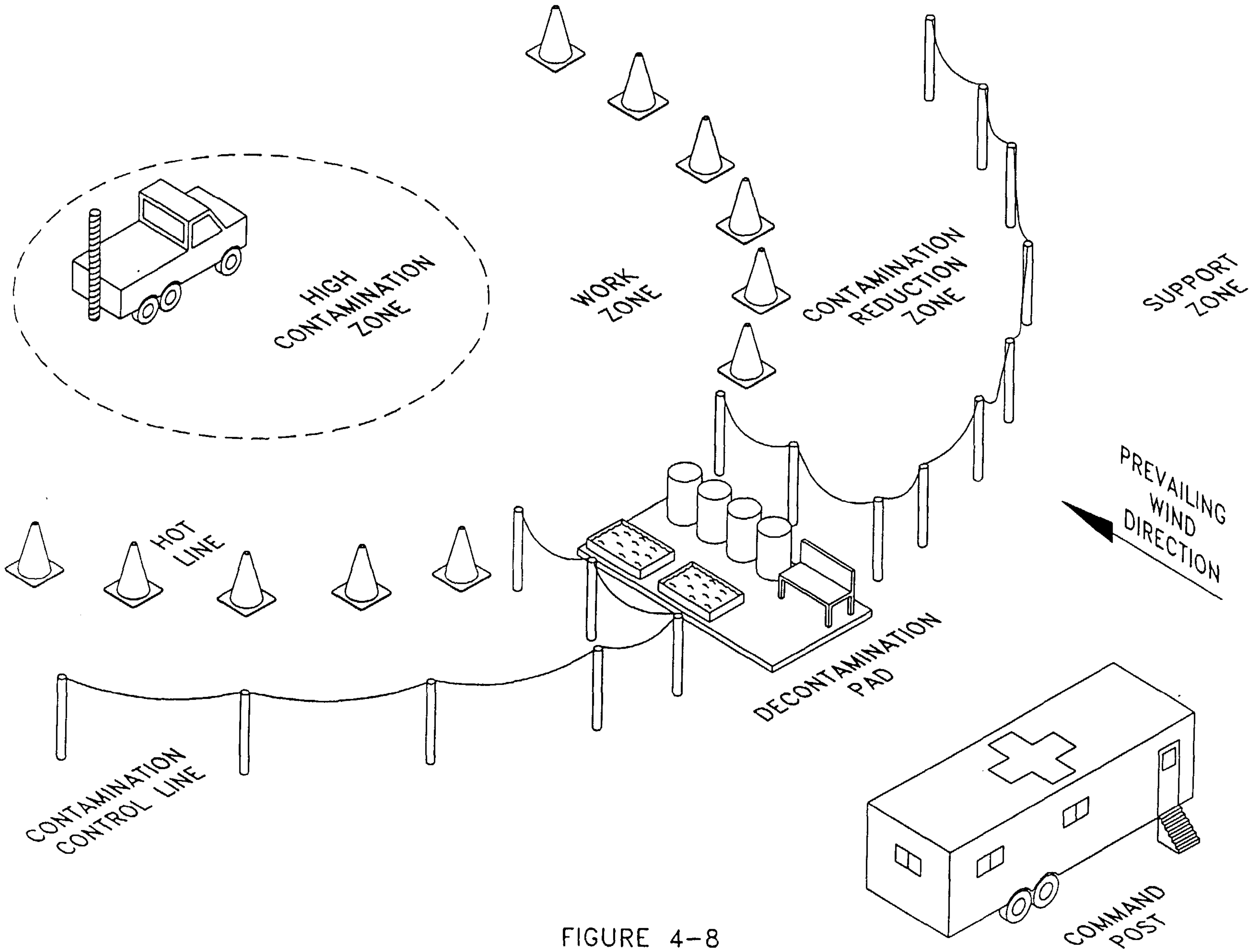


FIGURE 4-8
SCHEMATIC DIAGRAM
GENERAL CONTAMINATION
REDUCTION ZONE LAYOUT

Baker Environmental, Inc.

CONZONEZ

- Subcontractors operating heavy equipment shall have a written Health and Safety Program and follow all applicable OSHA regulations.

- Personnel, other than the operator, should not ride on equipment.

- A "spotter" will be used to help direct the heavy equipment operator.

- Personnel are to remain in the field of vision of the operator and remain clear of moving parts.

- Hand signals will be prearranged between operator and personnel working around the heavy equipment.

- Backup alarms must operate properly on the heavy equipment.

- Excavations are not to be entered by personnel; these are being dug for exploratory purposes. Personnel are to remain a safe distance from the excavated area.

- Excavated areas are not to be left unattended and are to be refilled daily.

- Utility clearances must be secured prior to digging (see Section 3.3.3.5).

4.5.2 Drilling Operations

The following safe work practices will be adhered to during drilling operations.

- The subcontracting drilling company's supervisor is to provide other cautions to be observed when working around the drill rig during the HASP briefing.

- Hand signals will be prearranged between operator and personnel working around the drill rig.

- Personnel are to remain in the field of vision of the operator and remain clear of moving parts where protective clothing can be entangled, i.e., Tyvek caught in the auger.

- Subcontractors operating heavy equipment shall have a written Health and Safety Program and follow all applicable OSHA regulations.

- Utility clearances must be secured prior to digging (see Section 3.3.3.5).

- Personnel working near a drill rig are to be aware of the location and operation of the emergency shut off devices.

4.6 Sanitation Procedures/Site Precautions

Provisions for sanitation procedures and site precautions to be followed on site are outlined below.

- A supply of clearly marked potable water, tightly closed, and equipped with a tap.

- Single service disposal cups.

- Outlets for non-potable water, clearly marked, for fire fighting or other purposes. Cross-contamination of the potable supply shall be prevented.

- One toilet facility for up to 20 personnel which is either chemical, recirculating, combustion, or flush, depending on local code requirements. Two toilet facilities will be required for greater than 20 personnel.

- A place for food handling meeting all applicable laws or suitable alternatives to such facilities will be provided (i.e., nearby restaurants, food wagons, etc.).

- Clean wash water will be available in the decontamination zone during Level C or B activities, and the Baker Field Trailer for all other operations. Disposable towelettes will be available in each Baker Field Vehicle for periodic cleanups.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated. Smoking will also not be allowed in areas where flammable materials are present. Hands and face must be thoroughly washed before breaking for meals and upon leaving the site. "Contaminated" work garments are not to be worn off site.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact lenses are <u>not permitted</u> to be worn on site.

- Facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is not permitted on personnel who are or may be required to wear respirators.

- Contact with contaminated or potentially-contaminated surfaces should be avoided. Wherever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, sit or place equipment on drums/containers.

- Medicine and alcohol can potentiate the effects of exposure to toxic chemicals, therefore, prescribed drugs should only be taken by personnel when approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided during after-hour operations.

- Alcoholic beverages and firearms are prohibited on site.

- All site personnel will observe any posted sign, warning, fence, or barrier posted around contaminated areas.

- Site personnel must wear the proper attire while on site. At a minimum, this will include steel-toed boots, work pants (e.g., jeans or other durable material), and work shirt (e.g., short or long-sleeved, made of a durable material). Tank tops, muscle shirts, and sweat pants are not permitted.

5.0 ENVIRONMENTAL MONITORING

The following section presents the monitoring to be performed during the work tasks of this project. This will consist of personal monitoring, point source monitoring, and perimeter monitoring. Due to the short duration and variability of field tasks only realtime air monitoring (versus integrated air monitoring) will be used to assess action levels. The action levels for the PID, as specified in Section 5.1 below, are based on a "worst-case" contaminant 8-hour TWA-PEL of 1 ppm (i.e., benzene, vinyl chloride, etc.), and are consistent with those listed by the USEPA in Section 6.9, of the Standard Operating Safety Guides (June, 1992).

5.1 Personal Monitoring

Personal monitoring will be accomplished using real time environmental monitoring instrumentation directed at the breathing zone (e.g., the area bordered by the outside of the shoulders and from the mid-chest to the top of the head) of work party personnel. Breathing Zone (BZ) monitoring will be performed each time a reading is taken at the point source. The guidelines below identify the protection levels required according to the concentration measured in the BZ.

Minicam (Model FM-3000) - To detect chemical warfare agents and stimulants. This will be used at Site A and possibly Sites 75 and 76.

- Site activities will immediately cease (upon alarm activation) personnel will back off to safe distance as identified by the TEU. An emergency evaluation with the TEU, SHSO, and Site Manager will be performed. Emergency decontamination will be performed as necessary.

PID(1) - Various levels of protection are being used with different tasks at the sites (refer to Section 6.2).

- Background (2) = Protection Level specified in Section 6.2.
- >1 mu above background in the breathing zone for up to 1 continuous minute = minimum Level C plus Dräger Tube Monitoring at the point source
- >1 mu above background in the breathing zone for up to 15 continuous minutes = Level B or Stop Work and consult PHSO
- Instantaneous peak concentrations >10 mu = Level B or Stop Work and consult PHSO

(1) PID with 11.7 eV ultraviolet lamp set on the 1 X Scale.
(2) Background is typically 1 to 2 mu (meter units)

Dräger Tubes(1) (used to determine if Level C or D+ protection levels are adequate for highly volatile constituents when a PID response meets the level identified above).

- Below limits of detection (BLD) to less than the Action Level (1/2 of the TWA(2)) = Level D/D+
- Action Level to the TWA = Level C (if adequate NIOSH certified air-purifying cartridge is available) or Stop Work and consult PHSO
- >The TWA = Level B or Stop Work and consult PHSO

(1) Dräger Tubes to be used include: Benzene (67 28561); Chloroform (67 28861)
Carbon tetrachloride (81 01021)

(2) Refer to Table 1, Section 3.0, for explanation.

5.2 Point Source Monitoring

Point source monitoring is defined by this HASP as monitoring performed at the source of the sampling/investigative activity. Instrumentation to be used will include a PID and an O_2/LEL meter. The action levels for the oxygen/combustible gas meter are identified below.

Oxygen/LEL Meter(1)

Oxygen Meter

- 19.5% to 23.5% = continue working
- <19.5% or >23.5% = stop work immediately and consult the SHSO

LEL Meter

- <10% of the Lower Explosive Limit (LEL) = continue working
- >10% of the LEL = Stop Work immediately and consult SHSO

(1)Used to evaluate physical safety in conjunction with PID.

As work progresses, the scope of monitoring may be extended based on monitoring results, odor detection, changing work conditions, and signs or symptoms of exposure. Any or all of these conditions will be immediately investigated and acted upon by the SHSO.

5.3 Perimeter Monitoring

Perimeter monitoring (defined as monitoring performed at borders beyond the Support Zone and often at the "fence line") for each site will be performed as follows:

- The PID will be used periodically to scan the perimeter as a means of documenting any volatile releases that may extend past the work zone, when volatile concentrations exceed 50 mu (2 X Scale) at the point source or 10 mu (1 X Scale) at the BZ.

- The Dräger Colorimetric Tubes, where specified in Section 5.1, will be used periodically to measure any potential releases when concentrations exceeding the TWA are detected at the BZ.

5.4 Site-Specific Air Monitoring Equipment and Frequency

Monitoring equipment and frequency for each site can be found in Table 5-1. Dräger Tubes are typically required when air concentrations reach a certain level according to an PID response. Action levels that govern changes in levels of protection can be found in Section 5.1.

5.5 Equipment Maintenance and Calibration

Baker's procedures for the return of equipment to inventory and for maintenance of the equipment shall be followed in order to assure that the optimum level of operation is maintained for the item. Equipment calibration of the monitoring instruments will be completed daily before each use and calibration information entered onto the equipment

TABLE 5-1

MONITORING EQUIPMENT AND FREQUENCY FOR EACH TASK CONDUCTED AT SITES A, 12, 68, 75, 76, 84, AND 85

Job Task	PID	LEL Meter	Minicam*
Sediment/Surface Water Sampling	I&P	▨	▨
Geophysical Investigation	D	▨	▨
Surface Soil Sampling	I&P	▨	C
Monitoring Well Installation	C	I&P	C
Monitoring Well Development	I&P	▨	C
Groundwater Sampling	I&P	▨	C
Soil Boring Sampling	C	I&P	C
Test Pit/Trenching	C	I&P	C
Hand Excavation	I&P	I&P	C

* Minicam for use at Sites A, 75, and 76.

I = Initially - At start of job task to confirm designated protection level.
P = Periodically - When site condition or set-up changes, or when a new area is entered.
C = Continuously - Monitor levels continuously.
D = At the discretion of the SHSO.
PID = Photoionization Detector

Note: As air concentrations are measured, they should be documented in the individual's field logbook. In the case of continuous monitoring, every 15 to 30 minutes.

calibration form. All forms will be maintained on site for the duration of the project with copies to be given to the Equipment Manager once the equipment has been returned to the office. Procedures for equipment maintenance and calibration can be found in the operating manual provided by the manufacturer (included with each piece of equipment), or in Baker's Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

5.6 Monitoring Documentation

As environmental monitoring is performed, documentation of the results will be entered into the Field Log Book of the SHSO or other personnel performing the monitoring. Documentation is to include the date, time, instrument result, general location, and specific location, such as, point source, breathing zone, or area. Copies of the Field Log Book will be placed in a binder and remain in the Baker Field Trailer until the end of the field activities, whereby the log sheets will become part of the permanent file.

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 Personal Protective Equipment Selection

The personal protective equipment available for the various levels of protection, is listed below. The assigned item number will be used in Section 6.2 for each field activity.

Item No.	Personal Protective Equipment
1	Chemical-Resistant Clothing (Polyethylene-coated Tyvek®)
2	Chemical-Resistant Clothing (Saranex®)
3	Uncoated Tyvek®/Kleenguard® Coveralls
4	Normal Work Clothes or Coveralls
5	Air-Line Respirator (ALR) with 5-minute escape pack
6	Self-Contained Breathing Apparatus (SCBA) for rescue
7	NIOSH 5-minute Escape Pack (on standby)
8	Full-face Cartridge Respirator
9	Half-face Cartridge Respirator
10	Full-face Cartridge Respirator (on standby)
11	Half-face Cartridge Respirator (on standby)
12	Chemical-Resistant Gloves (Nitrile inner-double layer)
13	Chemical-Resistant Gloves (Nitrile inner-single layer)
14	Chemical-Resistant Gloves (Rubber/Neoprene outer)
15	Chemical-Resistant Gloves (Nitrile outer)
16	Work Gloves (outer)
17	Chemical-Resistant Overboots (with steel toe and shank)
18	Chemical-Resistant Overboots (w/o steel toe)
19	Steel Toe Boots
20	Safety Glasses
21	Safety Goggles
22	Face Shield
23	Hard Hat
24	Hearing Protection(1)
25	Chest/Hip Waders
26	Safety Vests

(1) At the discretion of the SHSO.

6.2 Site-Specific Levels of Protection

Based on an evaluation of potential hazards the levels of protection and corresponding personal protective equipment have been designated for the following field activities. Upgrading or downgrading the level of protection will be based on real-time monitoring, working conditions, and the discretion of the SHSO.

Note: No single combination of protective equipment and clothing is capable of protection against all hazards. PPE should be used in conjunction with safe work practices, effective decontamination, and good personal hygiene.

Site(s)	Field Activity	Level of Protection					Personal Protective Equipment (Item No.)
		B	C	D+	D	Other	
68 and 84	Sediment/Surface Water Sampling			X			4, 12, 15, 18, 19, 20
A	Soil Sampling		X				2, 8, 12, 15, 19, 20
75 and 76	Geophysical Investigation				X		4, 19
12, 68, 84, and 85	Soil Sampling			X			4, 12, 15, 19, 20
12, 68, 84, and 85	Monitoring Well Installation			X			4, 12, 15, 19, 20, 24
75 and 76	Monitoring Well Installation		X				2, 8, 12, 15, 18, 19, 23, 24
12, 68, 84 and 85	Monitoring Well Development			X			4, 12, 15, 19, 20, 24
75 and 76	Monitoring Well Development		X				2, 8, 12, 15, 18, 19, 24
12, 68, and 85	Groundwater Sampling			X			4, 12, 15, 19, 20
75 and 76	Groundwater Sampling		X				2, 8, 12, 15, 18, 19
A	Hand Excavation		X				2, 8, 12, 15, 18, 19
68	Soil Boring - Sampling			X			4, 12, 15, 19, 20, 24
75, and 76	Soil Boring - Sampling		X				2, 8, 12, 15, 18, 19, 24
A	Test Pit/Trenching	X					2, 5, 12, 15, 18, 19, 23

Level C protection is not for chemical warfare agents. Any indication of chemical warfare agents will initiate immediate shutdown, evacuation, and evaluation.

6.3 Respiratory Protection

Site-specific respiratory protection requirements as outlined below will comply with the procedures in Attachment A - Baker Safety SOPs.

6.3.1 Level B

The "North" NIOSH-certified Air Line Respirator (ALR) system (four-person manifold) with 5-minute escape pack will be used at this level. The line-of-site worker will be equipped with an SCBA on standby for emergency rescue purposes. This individual may also be responsible for monitoring the supplied air system (comprised of a bank of compressed gas cylinders containing Grade D breathing air) with the SHSO's approval.

6.3.2 Level C

The "North" or "MSA" full-face NIOSH-certified negative pressure Air-Purifying Respirator (APR) with an organic vapor and HEPA filter cartridge is the appropriate cartridge for use with the detected hazardous materials and the detected contaminant (refer to Work Plan) concentrations. Upgrades/downgrades in this level of respiratory protection will be based on measured real-time air contaminant concentrations (see Section 5.7) and the SHSO's observations. This level of protection is not suitable for chemical warfare agents. If chemical warfare agents are detected visually by the TEU or by air monitoring, personnel will immediately **EVACUATE** the area.

Cartridge changeover will occur when one or more of the following have been observed: exposure duration greater than eight hours for vapor/gas cartridges; breathing resistance; a noticeable odor or taste; eye/throat irritation; and other indicators such as end-of-service life indicators for specialty filter cartridges. Records of current respirator fit-testing will be maintained at the Baker Command Post.

6.3.3 Level D+

A NIOSH-certified negative pressure APR, meeting all the requirements identified under Level C, will remain on standby at this level.

6.4 Care and Cleaning of Personnel Protective Equipment

Provisions for the care and cleaning of personal protective equipment used on site can be found in Attachment A - Baker Safety SOPs.

7.0 DECONTAMINATION PROCEDURES

7.1 Personnel Decontamination

Personnel leaving the Work Zone will be thoroughly decontaminated. The following protocol will be used for the decontamination stations according to levels of protection:

Level D	Level D+	Level C	Level B
1. Equipment drop	1. Equipment drop	1. Equipment drop	1. Equipment drop
2. Boot and glove gross contamination removal*	2. Outer boot and glove wash	2. Outer boot and glove wash	2. Outer boot and glove wash
3. Boot and glove wash*	3. Outer boot and glove rinse	3. Outer boot and glove rinse	3. Outer boot and glove rinse
4. Boot and glove rinse*	4. Tape Removal	4. Tape Removal	4. Tape Removal
5. Tape Removal*	5. Outer boot and glove removal	5. Outer boot and glove removal	5. Outer boot and glove removal
6. Boot removal*	6. Coverall removal/ disposal	6. Coverall removal/ disposal	6. SCBA or escape tank removal
7. Glove removal*	7. Inner glove removal/disposal	7. Respirator removal	7. Coverall removal/ disposal
8. Hand/Face wash	8. Hand/face wash	8. Inner glove removal/disposal	8. SCBA or ALR face shield removal
9. Equipment wipe down	9. Equipment cleaning	9. Hand/face wash	9. Inner glove removal/disposal
		10. Respirator cleaning/ sanitizing	10. Hand/face wash
		11. Equipment cleaning	11. Respiratory cleaning/ sanitizing
			12. Equipment cleaning

*Optional - depends on degree of contamination and type of PPE used.

The following decontamination equipment is required for Level C and higher protection levels and recommended for Level D+ protection:

- Shower trailer (located at Sites A, 75, and 76)
- Four small tubs (two sets of wash and rinse water)
- Scrub brush
- Towels*
- Disposable wipes*
- Pressurized sprayers for rinsing
- Contaminated clothing disposal bag or drum*
- Contaminated liquids disposal drum
- Respirator cleaning solution
- Liquinox and water as the decontamination solution
- Five (5) percent sodium hypochlorite solution (specifically for Sites A, 75, and 76)

*Minimum for Level D decontamination.

The decontamination liquids and clothing will be contained and disposed according to policy defined in the Sampling and Analysis Plan (SAP). Emergency shower and eye wash capabilities will be made available at Sites A, 74, and 75 in the event of suspected chemical agent contact. See Section 8.7 for further details on emergency decontamination procedures.

7.2 Effectiveness of Personnel Decontamination

The effectiveness of site decontamination methods will be evaluated by the SHSO on a periodic basis. This evaluation may include the observation of personnel decontamination, inspection of PPE before and after decontamination, and questioning site personnel for signs and symptoms of exposure. Additional measures may also be employed by the SHSO at their discretion.

7.3 Equipment Decontamination

The portion of the drilling and trenching equipment that will contact intrusive materials (i.e., augers and backhoe bucket) will be decontaminated prior to and upon completion of work in each area. Pressurized steam cleaning will be used to clean the equipment. Field sampling equipment will be cleaned using a 5 percent sodium hypochlorite solution at Sites A, 75, and 76.

Pressure steam cleaning will be conducted by the subcontractor. A portable steam cleaning unit will be used for the cleaning. Decontamination will be conducted at specific locations established at each site.

8.0 EMERGENCY PROCEDURES

8.1 Scope

The activities to be conducted under this HASP are not remediation (cleanup), but investigative, therefore the potential for a "release" to air, water or soil is low. However, other emergencies, such as fire or personnel injury may occur. If so, local emergency response groups will be called in to handle the incident, as necessary.

8.2 Pre-Emergency Planning

All applicable Navy/local emergency response contacts (On-Scene Commander, Fire Department, Security, Ambulance, Hospital, etc.) at MCB Camp Lejeune will be contacted prior to or during site mobilization activities. This notification will be performed by the SHSO and/or Site Manager. The information discussed may include:

- A description of site activities.
- Anticipated site hazards.
- Hazardous chemicals to be used on site.
- Expected length of time on site.
- Specific requirements the emergency response facilities may require.
- Confirmation of emergency phone numbers.

Specific points of contact, where applicable, will be established and added to the HASP. If requested, Material Safety Data Sheets will be provided at this time.

8.3 Emergency Coordinator

The SHSO acting as the Emergency Coordinator is responsible for field implementation of these Emergency Procedures. The Emergency Coordinator is responsible for reacting (not responding) to emergencies. As the Emergency Coordinator, specific duties include:

- Familiarizing all on-site personnel with the emergency procedures and the emergency coordinator's authority.

- Identifying the nearest telephone in the event of an emergency.

- Communicating site emergency procedures and requirements to all Baker and subcontractor personnel.

- Specifying the Site Manager as the backup/alternate Emergency Coordinator.

- Controlling activities of subcontractors and contacting the emergency response groups, as necessary.

- Anticipating, identifying, and assessing, fires, explosions, chemical releases, and other emergency situations to the best of their abilities, and providing this information to the off-site emergency groups) responding..

- Familiarity with site personnel trained in emergency first aid and adult CPR.

All on-site personnel, whether involved in emergency response or not, will be notified of their responsibilities by the Emergency Coordinator in an emergency. They will be familiar with the emergency procedures and the Emergency Coordinator's authority.

8.4 Communications

Internal communications will rely on direct communication (via verbal or two-way radios) between site personnel. External communications will employ a telephone located in the field trailer and a cellular (portable) telephone in the investigation areas.

The "Buddy System" will be in effect at all times; any failure of communication requires an evaluation of whether personnel should discontinue activities.

Air horns will be used for communication during emergency evacuation of site personnel. One long (3 second) air horn blast is the emergency signal to indicate that all personnel should evacuate the Work Zone.

Hand signals will be used in case of failure of radio communications or when radio communications are not available:

Hand gripping throat .... - Can't breathe (typically Level C/B activities)
Grip partner's wrist or both hands around waist ... - Leave area immediately
Hands on top of head .... - Need assistance
Thumbs up .... - OK, I am all right, I understand
Thumbs down .... - No, I do not understand

Coordination between Baker and subcontractor personnel is the responsibility of the Site Manager. The best means for securing the lines of communication will be determined prior to start-up by on-site project personnel.

Emergency telephone numbers will be posted in the Baker Field Trailer and maintained in each Baker Field Vehicle. The list of emergency phone numbers is presented in Table 8-1.

8.5 Assembly Area

In the event of an emergency personnel will be instructed before the start of operations to meet upwind of the emergency. Where applicable, personnel will exit the work area through the contamination reduction zone. At this location, emergency needs will be provided, such as:

- Assembly for evacuated personnel
- First aid for injured personnel
- Decontamination material
- Communications.

8.6 Emergency Hospital Route

An emergency hospital route figure (Figure 8-1) showing the location of the local hospital will be posted in the Baker Field Trailer and at strategic locations throughout the site. Personnel will be informed of the location of the figure and the directions to the hospital. The Naval Hospital will be used for life-threatening injuries or potential chemical exposure (per prior civilian humanitarian agreement). Directions to the Base and Public Hospital from each site are provided below.

TABLE 8-1

MCB CAMP LEJEUNE EMERGENCY TELEPHONE NUMBERS

Agency/Facility	Telephone Number	Contact*
Security (Police)	911 or (910) 451-3855	Response Operator
Fire	911	Emergency Services Operator
Ambulance (On-Base)	911 or (910) 451-4554	Emergency Services Operator/HM1 Cesse
Ambulance (Off-Base)	(910) 455-9119	Response Operator
Hospital (On-Base)	911 or (910) 451-4840, 4841, and 4842	Response Operator
Hospital (Off-Base) (Emergency Room)	(910) 577-2240	Emergency Room Physician
Hospital (Off-Base) (Information)	(910) 577-2345	Onslow County Hospital Information
Hazardous Materials Team	911	Emergency Services Operator
On-Scene Commander	911 or (910) 451-5815	Fire Chief Piner
Public Works Department (Underground Utilities via EMD Contact)	(910) 451-5068	Neal Paul
Poison Control Center	1-800-672-1697	Response Operator
National Response Center	1-800-424-8802	Response Operator
CHEMTREC	1-800-424-9300	Response Operator
Agency for Toxic Substances and Disease Registry	1-404-639-0615	Response Operator
MCB Camp Lejeune Directory Assistance	(910) 451-1115	Directory Assistance Operator
Air Station Security	(910) 451-6113	Provost Marshall
Air Station Fire Department	(910) 451-6620	Emergency Services Operator

* Remaining points of contact will be identified prior to the start of activities.

Notes: 1. When using the portable cellular telephone, in the Jacksonville, North Carolina area, dial the appropriate area code (910) first in addition to the local phone number.

2. When calling 911 on a non-base phone, ask emergency services operator to transfer call to Base 911 system and report emergency.

3. When using an on-base phone, first dial extension 99 for local calls or extension 92 for long distance calls.

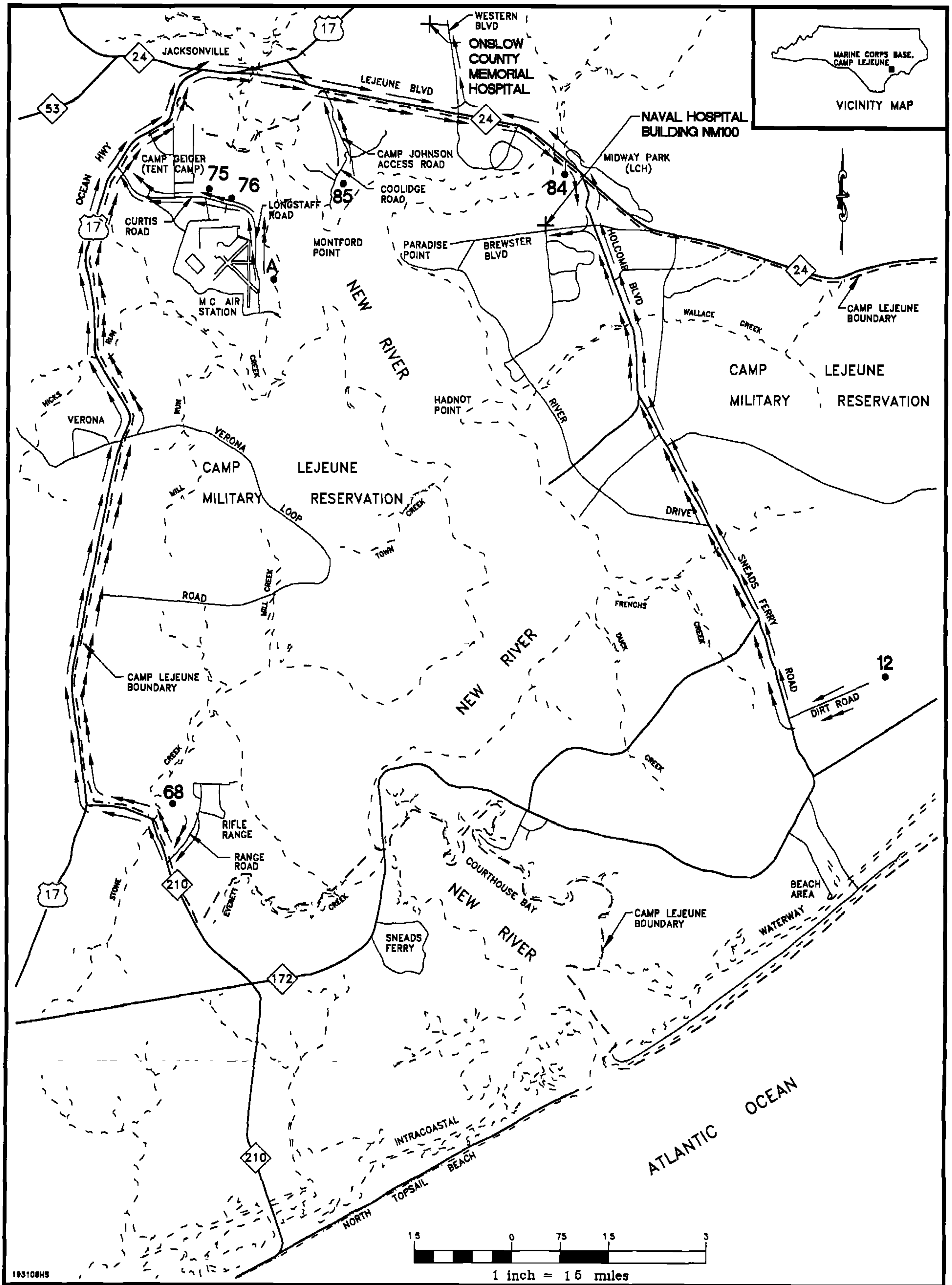


FIGURE 8-1
HOSPITAL ROUTE MAP
MARINE CORPS BASE CAMP LEJEUNE

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

00112877

Site A

The following are directions to the base Naval Hospital (Building NH100) from **Site A** (refer to Figure 8-1):

1. Leave Site A and follow Longstaff Road north to Curtis Road west.
2. Turn right and head north on Route 17 until intersecting with Route 24 (Lejeune Boulevard).
3. Turn right onto Route 24 (Lejeune Boulevard) and continue following Lejeune Boulevard through the main gate.
4. At traffic light turn right onto Brewster Boulevard.
5. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).
6. Follow signs for emergency room entrance (bear to right).

Directions to Onslow County Memorial Hospital (317 Western Boulevard) from **Site A** (refer to Figure 8-1).

1. Leave Site A and follow Longstaff Road north onto Curtis Road west to Camp Geiger main gate.
2. Turn right and head north on Route 17 until intersecting with Route 24 (Lejeune Boulevard).
3. Turn right onto Route 24 (Lejeune Boulevard) until intersecting with Western Boulevard.
4. Turn left onto Western Boulevard.
5. Continue on Western Boulevard to the fifth stop light and the hospital will be on the left hand side.
6. Follow directions to emergency room entrance.

Sites 75 and 76

The following are directions to the base Naval Hospital (Building NH100) from Sites 75 and 76 (refer to Figure 8-1):

1. Turn right onto Curtis Road and head to Camp Geiger main gate.
2. Turn right and head north on Route 17 until intersecting with Route 24 (Lejeune Boulevard).
3. Turn right onto Route 24 (Lejeune Boulevard) and continue following Lejeune Boulevard through the main gate.
4. At traffic light turn right onto Brewster Boulevard.
5. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).
6. Follow signs for emergency room entrance (bear to right).

Directions to Onslow County Memorial Hospital (317 Western Boulevard) from Sites 75 and 76 (refer to Figure 8-1).

1. Turn right onto Curtis Road and head to Camp Geiger main gate.
2. Turn right and head north on Route 17 until intersecting with Route 24 (Lejeune Boulevard).
3. Turn right onto Route 24 (Lejeune Boulevard) until intersecting with Western Boulevard.
4. Turn left onto Western Boulevard.
5. Continue on Western Boulevard to the fifth stop light and the hospital will be on the left hand side.
6. Follow directions to emergency room entrance.

Site 68

The following are directions to the base Naval Hospital (Building NH100) from Site 68 (refer to Figure 8-1):

1. Travel Range Road south to Highway 210.
2. Travel Highway 210 west to Route 17.
3. Proceed north on Route 17 until intersecting with Route 24 (Lejeune Boulevard).
4. Turn right onto Route 24 (Lejeune Boulevard) and continue following Lejeune Boulevard through the main gate.
5. At traffic light turn right onto Brewster Boulevard.
6. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).
7. Follow signs for emergency room entrance (bear to right).

Directions to Onslow County Memorial Hospital (317 Western Boulevard) from Site 68 (refer to Figure 8-1).

1. Travel Range Road south to Highway 210.
2. Travel Highway 210 west to Route 17.
3. Proceed north on Route 17 until intersecting with Route 24 (Lejeune Boulevard).
4. Turn right onto Route 24 (Lejeune Boulevard) until intersecting with Western Boulevard.
5. Turn left onto Western Boulevard.
6. Continue on Western Boulevard to the fifth stop light and the hospital will be on the left hand side.
7. Follow directions to emergency room entrance.

Site 12

The following are directions to the base Naval Hospital (Building NH100) from Site 12 (refer to Figure 8-1):

1. Travel west on undeveloped dirt road to Sneads Ferry Road.

2. Turn right and travel north on Sneads Ferry Road to Holcomb Boulevard and bear right at yield sign.

3. Travel north on Holcomb Boulevard to traffic light and turn left on Brewster Boulevard.

4. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).

7. Follow signs for emergency room entrance (bear to right).

Directions to Onslow County Memorial Hospital (317 Western Boulevard) from Site 12 (refer to Figure 8-1).

1. Travel west on undeveloped dirt road to Sneads Ferry Road.

2. Turn right and travel north on Sneads Ferry Road to Holcomb Boulevard and bear right at yield sign.

3. Travel north on Holcomb Boulevard to traffic light and head straight to main gate.

4. Leave base through the main gate (via Holcomb Boulevard).

5. Take Highway 24 west to Western Boulevard and turn right.

6. Continue on Western Boulevard to the fifth stop light and hospital will be on the left.

7. Follow directions to the emergency room entrance.

Site 84

The following are directions to the base Naval Hospital (Building NH100) from **Site 84** (refer to Figure 8-1):

1. Turn right onto Route 24 (Lejeune Boulevard) and continue following Lejeune Boulevard through the main gate.

2. At traffic light turn right onto Brewster Boulevard.

3. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).

4. Follow signs for emergency room entrance (bear to right).

Directions to Onslow County Memorial Hospital (317 Western Boulevard) from **Site 84** (refer to Figure 8-1).

1. Turn left onto Route 24 (Lejeune Boulevard) until intersecting with Western Boulevard.

2. Turn right onto Western Boulevard.

3. Continue on Western Boulevard to the fifth stop light and the hospital will be on the left hand side.

4. Follow directions to emergency room entrance.

Site 85

The following are directions to the base Naval Hospital (Building NH100) from Site 85 (refer to Figure 8-1):

1. Turn left onto Coolidge Road and left onto the Camp Johnson access road.
2. Head straight and turn right onto Route 24 (Lejeune Boulevard) and continue following Lejeune Boulevard through the main gate.
3. At traffic light turn right onto Brewster Boulevard.
4. Continue on Brewster Boulevard until intersecting with driveway to Naval Hospital on right (approximately 0.75 miles).
5. Follow signs for emergency room entrance (bear to right).

Directions to Onslow County Memorial Hospital (317 Western Boulevard) from Site 85 (refer to Figure 8-1).

1. Turn left onto Coolidge Road and left onto the Camp Geiger access road.
2. Head straight and turn right onto Route 24 (Lejeune Boulevard) and continue following Lejeune Boulevard through the main gate.
3. Turn right onto Western Boulevard.
4. Continue on Western Boulevard to the fifth stop light and the hospital will be on the left hand side.
5. Follow directions to emergency room entrance.

8.7 Emergency Medical Treatment

If injuries are not serious or life threatening, affected personnel may be transported by other site personnel to the local medical facility, if necessary. Emergency medical response personnel will be contacted in the event of serious or multiple injuries. Medical personnel will be provided with all available information regarding the nature of the incident, chemicals involved, etc.

8.7.1 Emergency Services

The nearest public hospital is Onslow County Memorial Hospital located at 317 Western Boulevard, Jacksonville, NC, phone No.: (99) 577-2240 (on base) and (919) 577-2240 or 911 (off base).

Note: For chemical emergencies, personnel must be transported to Building NH100 (Naval Hospital).

Local ambulance service is available from the Naval Ambulance Service at 911 and the City of Jacksonville at (919) 455-9119. Contact should be made with emergency personnel prior to the start of activities (See Section 8.1).

There will be a minimum of 2 persons on each site that will be trained in emergency first aid and CPR. These personnel will also be familiar with Baker's program on potential exposure to Bloodborne Pathogens as outlined in the Baker Safety SOPs in Attachment A.

Instances requiring treatment beyond "first-aid" will be handled at appropriate facilities and reported to the Project Manager and PHSO within 24 hours. Subcontractors will be responsible for securing proper medical attention for their employees. Baker may assist the subcontractor if necessary.

8.7.2 Physical Injury

If an employee working in a contaminated area is physically injured, first aid procedures are to be followed. If the employee can be moved, he/she will be taken to the edge of the work area and decontaminated, if necessary (refer to Section 8.7). Depending on the severity of the injury, emergency medical response from Navy personnel may be sought to stabilize victim for transport to public hospitals. Emergency first aid may be administered by Baker personnel prior to transporting to an awaiting ambulance or to a local emergency medical facility, as appropriate.

8.7.3 Chemical Injury

If the injury to a worker is chemical in nature (e.g., direct contact/exposure), the following first aid procedures are to be instituted:

- Eye Exposure - If contaminated solid or liquid gets into the eyes, wash the eyes immediately at the 15-minute emergency eyewash station (or with the emergency eye wash bottle when an eye wash station if not available). Obtain medical attention immediately.

  NOTE: Contact lenses will not be worn while working at the site.

- Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solids or liquids penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medical attention immediately.

- Swallowing - If contaminated solid or liquid has been swallowed immediately contact the Poison Control Center at the Duke University Medical Center, Durham, North Carolina at 1-800-672-1697. Do not induce vomiting in an unconscious person. Obtain medical attention as directed by the Poison Control Center.

- Breathing - If a person has difficulty breathing, move the exposed person to fresh air at once. If breathing is not evident, check for pulse and perform appropriate first aid (either rescue breathing or CPR) depending on the condition. Obtain medical attention immediately.

8.7.4 Snakebite Injury

In the event of a snakebite injury, the following procedures will be followed.

Look for signs and symptoms such as the characteristic appearance of two small holes, usually about a half inch apart, with surrounding discoloration, swelling, and pain. Systematic signs (which may or may not occur) including weakness, sweating, faintness, and signs of shock.

Provide treatment as follows:

1. Calm the victim and keep affected area still.

2. Contact ambulance if you cannot provide the victim with transportation to the nearest medical facility.

3. Wash the wound.

4. Keep the affected area below the level of the heart if bite is on the arm or leg.

5. Treat for shock.

6. Monitor airway, breathing, and circulation.

7. Obtain physical description of snake, if possible.

8. Provide the emergency medical responder (either the ambulance attendant or the emergency room at the hospital) with all pertinent information such as: how long ago the bite occurred, the type of snake (if known), any known allergic conditions (if known), etc.

9. Inform the SHSO immediately if a snakebite injury has occurred.

8.8 Emergency Decontamination Procedures

In the event of a medical emergency, patients are to be adequately decontaminated before transfer (if possible) to prevent contamination of the medical transport vehicle and medical facility. Emergency personnel decontamination will include the following, depending on the level of protection.*

Level D	Level D+	Level C	Level B
• Equipment drop • Tape, boot, and glove removal • Coverall removal	• Equipment drop • Tape, outer boot, and glove removal • Coverall removal/ disposal • Inner glove removal/ disposal	• Equipment drop • Tape, outer boot, and glove removal • Coverall removal/ disposal • Respirator removal • Inner glove removal/ disposal	• Equipment drop • Tape, outer boot, and glove removal • SCBA or escape tank removal • Coverall removal/ disposal • SCBA or ALR face shield removal • Inner glove removal/ disposal

* If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination and wrap injured personnel with clean garments/blankets, to avoid contaminating other personnel or transporting equipment.

If chemical agent exposure suspected, personnel are to wash affected skin area with 5 percent sodium hypochlorite solution and use the shower in the trailer. A 15-minute emergency eye wash station will also be available.

All emergency personnel are to be immediately informed of the injured person's condition and potential contaminants and provided with all pertinent chemical data.

If necessary, one of the site personnel equipped with appropriate PPE may accompany the injured worker and perform decontamination with supervision of medical personnel.

8.9 Personal Protection and First Aid Equipment

PPE available for emergency response will include the following:

- Polyvinyl chloride boots
- Saranex® suits
- Tyvek® suits, polyethylene coated and uncoated
- Nitrile gloves (inner and outer)
- Neoprene and Nitrile Gloves (outer)
- Face shields and goggles
- SCBA

PPE and first aid equipment will be available in the support zone (i.e., Baker Field Vehicle or Baker Site Trailer).

Emergency and first aid equipment can be found at the following locations:

Fire Extinguisher:	Baker Site Trailer and Contractor Field Vehicle
First aid kit:	Baker Site Trailer and Baker Field Vehicle
Emergency eye wash bottle:	Baker Site Trailer and Baker Field Vehicle
Air Horn:	With Personnel
15-minute Emergency Eye Wash Station:	Near Area With Greatest Potential for Chemical Splash/Exposure

8.10 Notification

If the Emergency Coordinator determines that the site has an uncontrolled situation, such as a spill, fire, or explosion, that could threaten human health or the environment, they will report their findings to the Base Fire Department, the Activity Contact, the Project Manager, and the NTR as soon as possible. The notification report will include:

- Description of incident (e.g., release, fire).
- Name and telephone number of individual reporting the emergency..
- Location of incident.
- Name and quantity of material (s) involved (if known).
- The extent of injuries, and number of casualties.
- The possible hazards to human health or the environment.
- Assistance that is requested.

Note: Prior to beginning ground intrusive activities at Site A, the officers housing area will be evacuated. This will be coordinated through the Base Representative.

8.11 Hazard Assessment

For the purposes of providing information to the Navy On-Scene Commander, the Emergency Coordinator will assess possible hazards to human health or the environment that may result from an uncontrolled situation, to the best of their abilities, incorporating the following steps, as appropriate.

- Assess the immediate need to protect human health and safety.
- Identify, where possible, the materials involved in the incident including exposure and/or release pathways and the quantities of materials involved.
- Inform appropriate personnel as identified in Section 8.10, who will determine if release of material(s) meets EPA requirements for reportable quantities for spills under the RCRA or CERCLA.

This assessment may consider both the direct and indirect effects of the chemical release, fire, explosion, or severe weather conditions (e.g., the effects of any toxic, irritating, or asphyxiating gases that are liberated).

8.12 Security

During activation of these Emergency Procedures, the Emergency Coordinator or his/her designated representative will control access to the site and maintain an incident log until the appropriate personnel, such as the Navy On-Scene Commander arrives and takes control. The incident log may include:

- Activities that have occurred since the incident was first reported.
- Rescue, response, and PPE used to evacuate personnel.

8.13 Emergency Alerting

Personnel Injury in the Work Zone:

- Initiate a verbal warning or one long airhorn blast and move all unaffected site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).

- Send the rescue team into the Work Zone (if required) to remove the injured person to the hotline.

- Have the SHSO and/or Site Manager evaluate the nature of the injury, and assure that the affected person is decontaminated according to Section 8.8.

- If required, contact an ambulance and/or the designated medical facility.

No persons shall reenter the Work Zone until an accident investigation is performed by the SHSO and/or the Site Manager.

Personnel Injury in the Support Zone:

- The Site Manager and SHSO will assess the nature of the injury; if the cause of the injury or loss of the injured person does not affect the performance of other site personnel, operations may continue.

- If the injury increases the risk to others, a verbal warning or one long airhorn blast shall be sounded and all remaining site personnel will move to the command post for further instructions.

- Activities on site will stop until the added risk is mitigated.

Fire/Explosion:

- Initiate a verbal warning or one long airhorn blast and move all site personnel to the support zone (for Level D/D+) or the CRZ (for Level C or higher).

- Alert the fire and security departments and move all nonessential personnel to the Baker Command Post to await further instructions.

- Activities will stop until the added risk is mitigated.

Personal Protective Equipment Failure:

- If any site worker experiences difficulty, failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately cease work activities, leave the Work Zone, and repair or replace the defective equipment.

- Reentry will not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure:

- If any other equipment on site fails to operate properly, the Field Team Leader shall notify the Site Manager and SHSO to determine the effect of this failure on site operations.

- If the failure affects the safety of site personnel, work with the equipment will cease until the situation is evaluated and appropriate actions taken.

In all situations, when an on-site emergency results in evacuation of the Work Zone, personnel shall not reenter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The HASP has been reviewed and, if appropriate, modified.
4. Site personnel have been briefed on any changes in the HASP.

8.14 Training

Site personnel will read the details in the Emergency Procedures prior to the initial HASP training. The Emergency Procedures will be reviewed by site personnel during the pre-entry briefing.

8.15 Spill Containment Procedures

In the event that a small, easily-controlled spill of hazardous substances (gasoline, oil, etc.) occurs during the implementation of field activities, spill containment will be utilized to prevent the additional migration of contaminants through the site area. Large, uncontrolled spills will be handled by qualified response organizations under the direction of the Base personnel and/or the Navy On-Scene Commander. Any release to soils or surface waters equaling or exceeding the reportable quantities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the USEPA Clean Water Act will immediately be reported to the Base Environmental Management Department.

Specific spill containment procedures will be dependent on the type of materials spilled and the type of environment affected. Potential spill containment procedures may include diking with absorbent material/pads, then removal or containment of the contaminated materials. Spill containment materials will be located within close proximity to the storage area of the hazardous substances in a manner such that the pathway remains accessible and free of obstructions. Spill containment materials available on site may include:

- Absorbent pads
- A roll of polyethylene sheeting
- Shovels
- Minimum of two empty 55-gallon drums

9.0 TRAINING REQUIREMENTS

Training requirements for site personnel are outlined in the sections below.

9.1 General

All Baker employees, subcontractors, or other personnel entering the site will need to have received training in compliance with the Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.120. Baker employees engaged in field activities which potentially expose workers to hazardous substances receive a minimum of 40 hours of instruction off site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. Key points of the 40-hour training include field demonstrations, respiratory fit testing and training, risk assessment, toxicology, chemical reactivity, use of monitoring equipment, downrange work procedures, site safety procedures, levels of protection, protective clothing, decontamination, and practical field exercises (which include donning, doffing, and working in personal protective ensembles for personal protection Levels A, B, and C).

In addition to the initial 40-hour training program, Baker requires site employees to receive an annual 8-hour refresher training course on the items specified by the 29 CFR 1910.120 standard. The general purpose of the 8-hour refresher is to ensure that personnel retain the knowledge necessary to be adequately protected, and stay current with proper site health and safety procedures.

Baker also requires that personnel involved with on-site employee supervision receive (in addition to 40 hours initial training and three days of supervised field experience) at least eight additional hours of specialized training at the time of job assignment. Training topics include, but are not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques. The 8-hour supervisory training is required to ensure that supervisors have the knowledge necessary to understand and use the various Health and Safety Programs and to implement the elements of the HASP. Table 9-1 provides the appropriate OSHA Training History for Baker Project Personnel.

TABLE 9-1

OSHA TRAINING HISTORY OF BAKER PROJECT PERSONNEL*

Personnel	Title/Role	Training Status	
Mr. Raymond Wattras	Project Manager	40-hr. training completed:	4/84
		Supervisory training:	9/91
		8-hr. refresher completed:	10/93
		First Aid Training:	NA
		CPR Training:	NA
		Medical surveillance:	7/93
Mr. Ronald Krivan	Project Health and Safety Officer	40-hr. training completed:	1/88
		Supervisory training:	1/89
		8-hr. refresher completed:	2/93
		First Aid Training:	2/93
		CPR Training:	2/93
		Medical surveillance:	4/93
To be Named in the HASP Final	Site Manager	40-hr. training completed:	
		Supervisory training:	
		8-hr. refresher completed:	
		First Aid Training:	
		CPR Training:	
		Medical surveillance:	
To be Named in the HASP Final	Site Health and Safety Officer/ Field Team Leader	40-hr. training completed:	
		Supervisory training:	
		8-hr. refresher completed:	
		First Aid Training:	
		CPR Training:	
		Medical surveillance:	
To be Named in the HASP Final	Environmental Scientist	40-hr. training completed:	
		Supervisory training:	
		8-hr. refresher completed:	
		First Aid Training:	
		CPR Training:	
		Medical surveillance:	

*Training history for contractor personnel will be maintained at the Command Post.

NA - Not Applicable

9.2 Site-Specific Training

Site-specific training, as discussed in Section 1.3, will consist of an initial health and safety briefing on the following information:

- Names of individuals responsible for site health and safety and methods of communicating safety and health concerns.
- Roles and responsibilities of site personnel.
- Site-specific health and safety hazards.
- Use of PPE.
- Work practices by which employees can minimize risk.
- Safe use of equipment on site.
- Recognition of symptoms and signs of exposure to hazardous materials.
- Site control measures.
- Decontamination procedures.
- Emergency procedures.
- Baker Hazard Communication Program.

The SHSO will conduct the initial site-specific training prior to the initiation of field activities.

10.0 MEDICAL SURVEILLANCE REQUIREMENTS

10.1 General

All personnel, who may be exposed to materials having potentially adverse and deleterious health effects, obtain a medical clearance from Baker's Board Certified Occupational Health Physician in accordance with 29 CFR 1910.120(f) prior to entry onto any site. Baker's corporate medical surveillance program establishes a medical baseline and monitors for symptoms of overexposure for individuals who participate in Preliminary Assessments, Site Inspections, Remedial Investigations, Feasibility Studies, and construction-phase services at sites covered by the Department of Labor, Occupational Safety and Health Administration (OSHA), Hazardous Waste Operations and Emergency Response Standard, 29 CFR 1910.120. The program includes a medical and work history and is intended to determine the individual's capability for performing on-site work, including wearing chemical protective clothing and respiratory protective equipment in a thermally-stressed environment.

All Baker employees that will be engaged in site activities covered by the 29 CFR 1910.120 standard receive a Group III physical examination by a licensed physician who is provided information on the individuals site activities, and exposure or anticipated exposure levels. This exam is received initially upon hire, then once every 12 months thereafter. More frequent medical examinations, consultations, and/or laboratory testing will be provided if the examining physician determines that an increased frequency of examination is required. A complete Group III medical exam includes parameters such as height, weight, vision, temperature, blood pressure, and a complete review of occupational and medical histories. Other tests in a Group III exam include chest x-rays, electrocardiogram, spirometry, urinalysis, and blood tests. Table 10-1 describes the medical surveillance testing parameters performed annually on Baker employees.

10.2 Site Specific

Prior to entry onto the site, all personnel, including subcontractors, will be required to provide medical clearance to the SHSO from their company physician in accordance with 29 CFR 1910.120(f), stating that they are physically capable of performing the activities required of them. The need for additional monitoring, dependent on information obtained during the site characterization, will be evaluated on a case-by-case basis. However, in the event that site employees are injured, receive a health impairment, develop signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or are exposed during an emergency incident to hazardous substances at concentrations that are or may be above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used, medical examinations and/or consultations shall be performed according to the following schedule:

1. As soon as possible following the emergency incident or development of signs or symptoms.
2. At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

Procedures to follow in the event of an exposure to a hazardous material/chemical are provided in Appendix C.

TABLE 10-1

MEDICAL SURVEILLANCE TESTING PARAMETERS*

Group II - Individuals Occasionally in the Field (10-30 days/year)

- Medical History (Physical Exam)
- Eye Exam
- EKG (baseline and for individuals over 40 years of age)
- Chest X-ray (baseline then every 5 years)
- Spirometry
- CBC with differential
- SMA 12 or 26 (liver enzyme scan)

Group III - Individuals Frequently in the Field (>30 days/year)

- Medical History (Physical Exam)
- Eye Exam
- EKG (baseline then annually for individuals over 40 years of age)
- Audiometry
- Chest X-ray (baseline then every 3 years)
- Spirometry
- CBC with differential
- SMA 12 or 26 (liver enzyme scan)
- Urinalysis (glucose scan)
- Specific Blood and Urine Tests (dependent on field exposure)**

Group III with Asbestos - Individuals frequently in the field whom also work with asbestos

- Group III testing with the Asbestos Medical Questionnaire w/Pulmonary Function Test ($FVC_{1.0}$ and $FEV_{1.0}$)

* The attending physician has the right to reduce or expand the medical monitoring on an annual basis as he/she deems necessary.

** To be performed for individuals identified by the attending physician as being chronically exposed to organic compounds.

11.0 HEALTH AND SAFETY PLAN APPROVAL

This HASP has been reviewed by the following personnel.

Mr. Ronald Krivan, CSP	PHSO	Barbara J Crump for RK
Name	Title	Signature
Mr. Raymond Wattras	Project Manager	R B Wattras
Name	Title	Signature
Mr. Joseph Rozum	QA/QC Reviewer	Joseph E. Rozum
Name	Title	Signature

12.0 DECLARATION OF HASP REVIEW

All site personnel indicated below, have reviewed and are familiar with this Health and Safety Plan for the Site Inspection at Sites A, 12, 68, 75, 76, 84 and 85 at Marine Corps Base Camp Lejeune, North Carolina.

(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)
(Name-Print)	(Company)
(Name-Sign)	(Date/Time)

Attachment A

Baker Environmental, Inc.

Safety Standard Operating Procedures

ATTACHMENT A

BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

*Not Applicable

**To be provided in the Final HASP.

Baker
Baker Environmental, Inc

2.0 - RESPIRATORY PROTECTION PROGRAM

This Respiratory Protection Program presents the elements necessary for administering a successful program. Attached at the end of this program is a copy of the following Baker Environmental, Inc. (Baker) forms:

- Qualitative Respirator Fit Test Record
- Air-Supplying Respirator Inspection Form
- Air-Purifying Respirator Inspection Form

2.1 PURPOSE

The purpose of the Baker Respiratory Protection Program is to govern the selection and use of respiratory protection by Baker personnel. This program is also designed to meet requirements of the Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910.134 and 1926.103, "Respiratory Protection."

2.2 SCOPE

This program applies to Baker SRN personnel who may be involved with potential respiratory hazards as part of their job duties. This program outlines the procedures to follow when respiratory equipment is required.

2.3 RESPONSIBILITY

Baker provides the necessary respiratory equipment to protect the safety and health of each Baker employee. The Baker SRN Project Health and Safety Officer (PHSO) and Project Manager are responsible for identifying the need for this Respiratory Protection Program at project sites. The Baker Site Health and Safety Officer (SHSO) and Site Manager are responsible for implementing and administering the Respiratory Protection Program in the field. Baker employees are to use and maintain the respiratory protection provided in accordance with training received and instructions outlined in this program.

2.4 HAZARD ASSESSMENT

The key elements of a respiratory protection program must start with an assessment of the inhalation and ingestion hazards present in the work area. Because Baker's services involve a variety of environmental and industrial hygiene studies, it is not practical to identify all possible hazards to which all employees could be exposed within the scope of this document. Therefore, it is essential that a task specific assessment be conducted prior to the initiation of any activities on a given project. This task specific assessment shall be part of the site-specific Health and Safety Plan (HASP).

After a task-specific assessment is completed and it is determined that there is a potential for airborne exposure concentrations to exceed the recommended limits, engineering and administrative controls should be implemented. If the exposure cannot be reduced, or it is not feasible to reduce the airborne exposure below the recommended limits, respirators will be selected by the PHSO and/or SHSO on the basis of:

- Toxicity
- Maximum expected concentration
- Oxygen levels
- Warning properties of the substance(s) involved
- Sorbent limitations
- Facepiece fit
- Mobility requirements
- Type of use (routine, escape, or emergency entry)
- Possibility of ingestion of toxic materials
- Respirator attributes

2.5 TRAINING

Each respirator wearer shall be given training, by a qualified individual, which will include explanations and discussions of:

- Opportunity to wear respiratory protection in an uncontaminated environment.
- Respirator fit testing (qualitative)
- The respiratory hazard(s) and what may occur if the respirator is not used properly.
- The reasons for selecting a particular type of respirator.
- The function, capabilities, and limitations of the selected respirator.
- The method of donning the respirator and checking its fit and operation.
- The proper wearing of the respirator.
- Respirator maintenance, repair, and cleaning.
- Recognizing and handling emergency situations.

Employees who have attended the 40-hour training in accordance with 29 CFR 1910.120 (HAZWOPER) will be provided with the basic information necessary to comply with the OSHA training requirements and will only need to attend a supplementary session provided by qualified Baker personnel. The annual HAZWOPER 8-hour refresher will serve to reinforce these issues on an annual basis. Records of the training and fit-testing will be maintained for a minimum of 30 years following termination of employment for each employee.

2.6 TYPES OF RESPIRATORS

Baker purchases and provides, as necessary, the following respirators:

- North Brand half-face (Model 7700) and full-face (Model 7600) air-purifying respirators

- North Brand positive pressure 30-minute Self-Contained Breathing Apparatus (SCBAs) (Model 800)

- North Brand positive pressure supplied airline respirators with 5-minute escape air cylinders (Model 85500).

- MSA Ultra Twin full-face respirator (Model 480263)

- MSA Comfo II half-face respirator (Model 479529)

Only respiratory equipment certified by the appropriate approval agencies (e.g., NIOSH, MSHA) according to Title 30, Part II of the Code of Federal Regulations, will be distributed to

Baker employees. All Baker employees who regularly perform tasks requiring respiratory protection will be issued their own half-face and/or full-face respirator, provided the employee can achieve a proper fit and is medically capable of wearing the equipment.

Because 30-minute SCBAs, positive pressure supplied airline respirators, and 5-minute escape air cylinders are used less frequently, this equipment will be distributed on an as-needed basis.

2.7 AIR QUALITY

Compressed air used for respiration shall be of high purity. Breathing air shall meet at least the requirements of the specification for Grade D Breathing Air (or higher) as described in Compressed Gas Association Commodity Specification G-7.1-1966. Breathing air may be supplied to respirators from cylinders; oxygen must never be used with air-line respirators.

Air cylinders shall be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 178). Air-line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air-line respirators with nonrespirable gases or oxygen.

Breathing gas containers (air cylinders) shall be marked in accordance with American National Standard Method of marking Portable Compressed Gas Containers to Identify the Material Contained, A48.1-1954; Federal Specification BB-A-1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG-B00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

Breathing air, as supplied by air compressors, shall be of high purity and meet the requirements of the specification for Grade D Breathing air (or higher) as described in Compressed Gas Association Commodity Specification G-7.1-1966.

The compressor for supplying air shall be equipped with necessary safety and standby devices. A breathing air-type compressor shall be used. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air-purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in the event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the specifications outlined above.

2.8 CLEANING AND MAINTENANCE

Respiratory equipment that is used on an as-needed basis shall be maintained by qualified personnel. This equipment shall be cleaned/sanitized, then rinsed and air-dried, after each use.

Respiratory equipment that has been issued to an employee shall be cleaned/sanitized then rinsed and air-dried by the wearer, (specified by OSHA in 29 CFR 1910.134) which ensures that it will be maintained in clean and good operating condition. Inspections shall be conducted on a regular basis during usage and prior to each project requiring the potential usage of the equipment.

Baker

Baker Environmental, Inc

AIR-PURIFYING RESPIRATOR INSPECTION FORM

Type (Full or Half-Face)	FACE PIECE					HEADSTRAPS OR HEADBANDS		RESPIRATOR INTERIOR			Inspected By (Initials)	Date Inspected
	Clean and Sanitized?	Cracks, Tears, or Holes?	Proper Shape and Flexibility?	Air Purifying Element Holders Operate Correctly?	Proper Storage Free From Heat, Dirt, Sunlight, etc.?	Signs of Wear or Tear?	Buckles Function Properly?	Foreign Material Under Valve Seat?	Cracks or Tears in Valves or Valve Bodies?	Valve Covers and Bodies in Good Condition and Installed Correctly?		

✓ = OK   X = Not OK

Baker
Baker Environmental, Inc

AIR-SUPPLYING RESPIRATOR INSPECTION FORM

Type (SCBA or SAR)	Cylinder Condition (Damaged or Undamaged)	Cylinder (Full or MT)	Facepiece and Hoses (Damaged or Undamaged)	Connections (Damaged or Undamaged)	Apparatus Complete (Yes/No)	Cleaned and Sanitized (Yes/No)	Remarks	Inspected By (Initials)	Date Inspected

Rev.: 3/94

Baker
Baker Environmental, Inc.

QUALITATIVE RESPIRATOR FIT TEST RECORD

TEST SUBJECT NAME ____
(last) (first) (initial)

DATE ______________ SOCIAL SECURITY NUMBER ______________

SEX (M/F) ______ AGE ______ DEPARTMENT ______________

RESPIRATOR MEDICAL DATE ________ RESPIRATOR TRAINING DATE ________

SPECIAL/UNUSUAL CONDITIONS/CONSIDERATIONS:

Yes	No		Yes	No	
☐	☐	Claustrophobia	☐	☐	Scars
☐	☐	Facial hair	☐	☐	Broken or crooked nose
☐	☐	Eyeglasses	☐	☐	Extreme facial dimensions
☐	☐	Contacts	☐	☐	Wrinkles
☐	☐	Other: ______________			

RESPIRATOR SELECTION

Manufacturer/Model	Size	Style	Result
	S ___ M ___ L ___	Half ___ Full ___	Pass ___ Fail ___
	S ___ M ___ L ___	Half ___ Full ___	Pass ___ Fail ___
	S ___ M ___ L ___	Half ___ Full ___	Pass ___ Fail ___

Testing Agent	Qualitative Test	Sensitivity Check
Isoamyl Acetate	Yes: ___ No: ___	Yes: ___ No: ___
Irritant Smoke	Yes: ___ No: ___	Yes: ___ No: ___
Other: ______________	Yes: ___ No: ___	Yes: ___ No: ___

TEST EXERCISES
(Check all that apply)

Normal Breathing	________	Talking	________
Deep Breathing	________	Bending	________
Head, Side to Side	________	Jaw Movements	________
Head, Up and Down	________	Rainbow Passage	________

COMMENTS: ____

Signed: ______________________ (Test Subject)

Signed: ______________________ (Technician/Instructor)

Rev.: 3/94

All respirators shall be stored in a plastic bag within a cool/dry location, in a manner that will protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. They shall be stored to prevent distortion of rubber or other elastomer parts. Cartridges will not be stored while attached to an air-purifying respirator at anytime.

Parts replacement and repairs shall be performed only by appropriate personnel. Equipment requiring repairs shall be reported to appropriate Baker personnel. Examples of inspection forms are included at the end of this text.

2.9 INSPECTIONS

At the time of cleaning, and before and after each use, respirators will be inspected. Deteriorated components will be replaced before the respirator is placed back into service, or the respirator will be replaced. Repair components must be obtained from the manufacturer of the respirator to maintain the NIOSH certification. Emergency-use respirators and self-contained breathing apparatuses (SCBAs) will be inspected after each use or at a minimum, once a month. Sample inspection forms for both air-purifying respirators and air supplying respirators are attached. These forms are required to be completed each time a respirator is inspected. However, during field projects in which a field logbook is in use, personnel may enter the appropriate information into their field logbook as an alternative to the inspection form. A list of the items to be covered during an inspection are as follows:

- Air-Purifying Respirator (full or half-face)
    - Face Piece
        - Clean and sanitized?
        - Cracks, tears or holes absent?
        - Proper shape and flexibility retained?
        - Air-purifying element holders intact?
        - Stored properly, free from heat, dirt, and sunlight?
    - Headstraps or Headbands
        - Signs of wear or tears?
        - Buckles function properly?
    - Respirator Interior
        - Foreign material under valve seat?
        - Cracks or tears in valves/valve bodies?
        - Valve covers/bodies installed properly?
- Supplied Air Respirators
    - Cylinder undamaged?
    - Facepiece and hoses undamaged?
    - Connections undamaged?
    - Apparatus complete?
    - Facemask cleaned and sanitized?
    - Hoses and connections cleaned?

Note: The date and the initials of the qualified individual performing the inspection must be entered into the field logbook.

2.10 FIT-TESTING

Each respirator wearer shall be provided with a respirator that can properly form a secure face-to-mask seal. Each wearer shall be fit-tested prior to issuance of the respirator using either an irritant smoke or odorous vapor, or other suitable test agent (see example of form at end of text). Retesting shall be performed, at a minimum, on an annual basis or if a different model respirator, other than the model the wearer was previously fit-tested for, is to be used. Air-purifying respirators fit-tested qualitatively will be assigned a protection factor of 10 (APF = 10). A copy of Baker's Fit-Test Form is attached.

Facial hair, which interferes with the normally effective face to mask seal, is prohibited. Each respirator wearer shall be required to check the seal of the respirator by negative and positive pressure checks prior to entering a harmful atmosphere.

2.11 MEDICAL SURVEILLANCE

Personnel who are or may be assigned to tasks requiring use of respirators shall participate in a medical surveillance program on an annual basis. The medical surveillance program shall include, but may not be limited to, a history of respiratory disease, work history, a physical exam, and spirometry conducted by the company's physician and at the expense of the company. Test parameters included in Baker's medical surveillance program are in each site-specific HASP.

2.12 LIMITATIONS

Wearing any respirator, alone or in conjunction with other types of protective equipment, will impose some physiological stress on the wearer. Therefore, selection of respiratory protective devices will be based on the breathing resistance, weight of the respirator, the type and amount of protection needed as well as the individual's tolerance of the given device. Additional concerns regarding the limitations of different types of PPE and the monitoring requirements for heat stress/strain will be addressed in the "Heat Stress" SOP.

2.13 SUBCONTRACTOR REQUIREMENTS

In compliance with Baker's respiratory protection program, all subcontractors under the direction of Baker personnel will be expected to comply with pertinent sections of OSHA Standards 1910.134 and 1926.103. Additionally, the subcontractor will be asked to:

- Provide documentation that their employees have been fit-tested on the air-purifying respirator the employee is expected to use.
- Provide documentation that their employees have been medically certified to wear a respirator.

3.0 - CARE AND CLEANING OF PERSONAL PROTECTIVE EQUIPMENT

3.1 INTRODUCTION

The following procedures cover the care and cleaning of Levels D, D+, C, and B personal protective equipment (ppe). Note: These are general procedures that apply to most situations and are not all inclusive. Procedures are subject to change at the direction of the Site Health and Safety Officer (SHSO).

3.2 INSPECTION

Proper inspection of personal protective equipment (PPE) features several sequences of inspection depending on articles of PPE and its frequency of use as follows:

- Inspection and operational testing of PPE received from the factory or distributor.
- Inspection of PPE as it is issued to workers.
- Inspection after use or training, and prior to maintenance.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The primary inspection of PPE in use for activities at the site will occur prior to immediate use, will be conducted by the user to ensure that the specific device or article has been checked out by the user, and that the user is familiar with its use.

3.2.1 <u>Chemical Resistant Suit (Levels D+ through B)</u>

- Determine if suit is the one specified in the Site Health and Safety Plan (HASP)
- Before donning, inspect suit for holes or tears; check to see that zippers are operable and look for signs of suit degradation.
- When wearing, avoid contact with contaminated material where possible; be aware of sharp objects that can tear suit; periodically look over suit to check for major rips or tears.
- While decontaminating, remove gross excess of material from suit; remove suit so that material does not contact inner suit; place clothing in properly labeled disposal containers.

3.2.2 <u>Inner/Outer Gloves (Levels D+ through B)</u>

- Determine if gloves meet the specifications in the site HASP.
- Look for rips, tears, or degradation of material. Replace as necessary or at the direction of the SHSO.

3.2.3 Chemically Resistant Boots (Levels D+ through B)

- Determine if boots meet the specifications in the site HASP.

- Nondisposable boots are to be examined on a daily basis before and after use. Disposable boots should be examined prior to donning and while in use, and disposed according to site procedures.

3.2.4 Safety (Steel Toe and/or Shank) Boots (Levels D through B)

- Examine daily for gouges, open seams, etc., anything that would lessen the integrity of the boot. Replace as boot becomes worn.

3.2.5 Hard Hats (Levels D through B)

- Should be visually inspected before donning for fit, cracks, and overall condition.

3.2.6 Safety Glasses/Goggles (Levels D through C)

- Should be visually inspected before donning for cracks, deteriorated parts, and overall condition. Replace as necessary.

3.2.7 Respirators (Levels D+ through B)

- Procedures for care of respiratory protective equipment are covered in Baker's SOP for Respiratory Protection.

3.2.8 Hearing Protection (Levels D through B)

- Disposable - Replace daily, or as material becomes worn or dirty.
- Reusable - Inspect before use, clean regularly, replace parts as necessary.

3.3 EQUIPMENT CLEANING

General procedures for cleaning of equipment are listed below. Site-specific concerns will be addressed by the SHSO prior to and during site activities. Cleaning of respiratory equipment is covered under the "Respiratory Protection Program" SOP.

3.3.1 Gross Physical Removal

Remove large amounts of contaminated soil or sediment by scraping off with a tongue depressor or other suitable instrument, then wipe off using a disposable wipe/paper towel.

3.3.2 Physical/Chemical Removal

Remove residual contamination with a soft-bristled, long-handled brush or equivalent using a nonphosphate detergent solution.

3.3.3 Rinsing/Dilution

The detergent solution and residual contaminants will be rinsed with distilled/tap water using a pressurized sprayer, a tub filled with clean wash water, or equivalent.

3.4 EQUIPMENT STORAGE

Storage of ppe is an important aspect to the daily care and cleaning therefore, the following considerations should be observed:

- Different types of ppe shall be stored in a clean and dry environment, free from elements that could damage ppe.
- PPE shall be stored and labeled so that site personnel can readily select the specified PPE.
- Contaminated, nondisposable ppe shall be decontaminated before returning to the storage area.
- Contaminated, disposable PPE shall not be returned to the storage trailer, but disposed according to the provisions identified in the Site Work Plans.

4.0 - BLOODBORNE PATHOGENS
(Safe Handling of First Aid Incidents)

4.1 PURPOSE

The purpose of the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens Standard, Title 29 CFR Part 1910.1030, is to protect workers from bloodborne pathogens such as the (HIV) and (HBV) by reducing or eliminating workers' exposure to blood and other potentially infectious materials. Although HIV and HBV are specifically mentioned by OSHA, the standard includes any bloodborne pathogen, such as Hepatitis C, malaria, and syphilis. The standard requires the employer to develop a written exposure control plan that will reduce or eliminate employee exposure, thus reducing their risk of infection.

The purpose of the Baker Environmental (Baker) exposure control plan is to minimize the possibility of transmission of bloodborne pathogens in the workplace by establishing procedures for the safe handling of first aid incidents that may expose personnel to blood or other potentially infectious materials.

4.2 SCOPE

All Baker SRN personnel who may be exposed to blood or other potentially infectious materials as part of their job duties are required to follow the guidelines set forth in this SOP. The exposure control plan shall be reviewed and updated at least annually, to reflect new or modified tasks and procedures that affect occupational exposure, and to reflect new or revised employee positions with occupational exposure.

4.3 RESPONSIBILITY

The Baker Project Health and Safety Office (PHSO) and Project Manager are responsible for implementing and administering this exposure control plan at project sites for their employees. These individuals will be assisted in the field by the Baker Site Health and Safety Officer (SHSO) who will be responsible for implementing the exposure control plan.

4.4 DEFINITIONS

Bloodborne Pathogens - Pathogenic microorganisms that may be present in human blood and has the potential to cause disease in humans. Two examples of bloodborne pathogens include, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Contaminated - Means the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Decontamination - Physically or chemically removing, inactivating, or destroying bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles, so that the surface or item is rendered safe for handling, use, or disposal.

Exposure Incident - A specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that result from the performance of an employee's duties.

Occupational Exposure - Reasonably anticipated skin, eye, mouth, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

Other Potentially Infectious Materials - Includes the following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; any unfixed tissue or organ (other than intact skin) from a human; and HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Parenteral - Piercing of the mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

Regulated Waste - OSHA defines a regulated waste as a liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid state if compressed; items caked with dried blood or other potentially infectious materials that are capable of release of these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

4.5 PROCEDURES FOR EXPOSURE TO BLOODBORNE PATHOGENS

The sections below will discuss the means by which Baker personnel can determine exposure potential, modes of transmission, methods of compliance, medical monitoring, and post exposure procedures.

4.5.1 Exposure Determination

The exposure determination is based upon the job classifications with occupational exposure potential, and the activities in which these exposures can occur, as follows.

Job Classifications

- Site Manager/Site Safety and Health Officer
- Environmental Scientists
- Geologists
- Other Baker Field Personnel

Exposure Activities

- Response to first aid incidents involving site personnel

- Decontamination of personnel, personal protective equipment, work surfaces, and equipment potentially exposed to blood or other potentially infectious materials

4.5.2 Modes of Virus Transmission in the Workplace

Modes of virus transmission are similar for the viruses of concern. Primarily, virus transmission occurs as the result of direct blood contact from percutaneous inoculation, contact with an open wound, non-intact skin (e.g. chapped, abraded, or dermatitis), or mucous membranes to blood, blood-contaminated body fluids, or concentrated virus. Protective measures for workers will focus on preventing exposure to blood and other body fluids that can result from an injury or sudden illness.

4.5.3 Methods of Compliance

4.5.3.1 Universal Precautions

The unpredictable and emergent nature of exposures likely to be encountered on a site may make differentiation between hazardous body fluids and those that are not hazardous very difficult. Thus, all employees will observe "Universal Precautions" to prevent contact with blood or other potentially infectious materials. These "Universal Precautions" stress that all blood or other potentially infectious materials will be treated as if they are known to be infectious.

The universal precautions will include:

(1) Cover the skin, especially open cuts, scrapes, skin rashes, or other broken skin.

(2) Don't touch objects that could be contaminated, such as blood-covered surfaces, clothing or linens.

(3) Cover mucous membranes (i.e., mouth, nose, and eyes).

(4) Prevent direct contact with sharps, such as needles, scalpels, or broken glass that could pierce or puncture your skin.

(5) Clean and decontaminate surfaces, containers, and equipment that may have been exposed to blood or other body fluids.

4.5.3.2 Standard Work Practices

Standard work practices are to be implemented at all times by all employees who may be exposed to blood or other potentially infectious materials. Work practices are defined as specific policies or procedures whose purpose is to reduce the potential for employee exposure to bloodborne pathogens. Work practices for use by site personnel are described in the balance of this section.

Personal Hygiene

All exposed employees will observe the following hygienic practices:

- During or immediately after exposure to blood or other potentially infectious materials; do not eat, drink, chew gum, chew tobacco, smoke, apply cosmetics, balms or medications, or any other activity that increases the potential for hand-to-mouth, mucous membrane, or skin contact.

- Following exposure to blood or other potentially infectious materials, personnel will wash their hands and any other exposed skin with a disinfectant soap and water after removal of chemical-protective gloves or other personal protective equipment (PPE). This will be performed before eating, urinating, defecating, applying make-up, smoking or undertaking any activity that may result in increased potential for hand to mouth, mucous membrane, or skin contact.

Personal Protective Equipment

The basic premise for wearing the appropriate PPE is that site personnel must be protected from exposure to blood and other potentially infectious materials. Appropriate PPE is available to all site personnel.

Responders to a medical emergencies will have access to the appropriate PPE. The PPE will be present in the site trailer and field vehicles. The PPE should be used in accordance with the level of exposure encountered. Minor lacerations or small amounts of blood do not merit the same extent of PPE use as required for massive arterial bleeding. Management of the patient who is not bleeding, and has no bloody body fluids, should not routinely require the use of PPE.

The following PPE will be present in each Baker Field Vehicle and/or the Baker Site Trailer.

1. Disposable chemical-protective gloves (i.e, nitrile or latex)
2. Resuscitation equipment*
3. Safety glasses, goggles, or faceshields
4. Tyvek® coveralls

* Resuscitation Equipment - Because the risk of salivary transmission of infectious disease during artificial ventilation of trauma victims, pocket mouth-to-mouth resuscitation masks will be present in the first aid kits. The pocket mouth-to-mouth resuscitation masks are designed to isolate response personnel from contact with the victims' blood and blood-contaminated saliva, respiratory secretions, and vomitus.

Decontamination procedures will follow those outlined in each site HASP.

Handling Regulated Wastes

With the exception of contaminated sharps, all other regulated wastes must be placed in closable, color-coded, labeled containers that prevent leakage of fluids. All applicable federal and state regulations must be followed for transporting and disposing of the wastes.

Training and Education

All employees with the potential for occupational exposure will receive initial training on the safe handling of first aid incidents during first aid/CPR Instruction, and subsequently during HASP briefings and annual training refreshers. See Appendix A for the Bloodborne Pathogens Training Outline.

4.5.4 Medical Monitoring

All Baker personnel will follow the guidelines established by Baker's Board Certified Health Physician in association with EMR, Inc.

4.5.5 Post-Exposure Procedures and Follow-Up management

The following subsections presents the procedures to follow when a first aid incident occurs involving the presence of blood or other potentially infectious material; specific steps need to be taken to safeguard the health of Baker site personnel.

4.5.5.1 First Aid Incident Report

If there is a reasonable cause to believe that a potential exposure to blood or other potentially infectious materials has been experienced, the employee must complete the steps listed below. These steps are required when non-HBV vaccinated first aid responders participate and regardless of whether an actual "exposure incident" occurred.

1. Immediately notify the SHSO. The SHSO will determine whether an "exposure incident" occurred.
2. Wash area of contamination and remove contaminated clothing to ensure that no further contamination will occur.
3. All parties involved will complete the Supervisors Incident Report Form and the incident will be reported to Baker's Human Resources office.

Non-HBV vaccinated Baker employees who render first aid where blood or other potentially infectious materials are present must be seen by a designated EMR physician within 24 hours of the incident. The employee must take a copy of the Supervisors Incident Report Form and a copy of OSHA Standard 1910.1030 to the physician.

Employees who respond to first aid incidents involving the presence of blood or other potentially infectious materials where the determination was made that an "exposure incident" occurred, have 90 days following baseline blood level collection to decide if they wish to have their blood tested for HIV.

The confidential medical evaluation and follow-up will include:

1. The circumstances of the exposure.
2. If consent has been obtained testing of the source individual's blood in order to determine HIV and/or HBV infectivity. If consent is not obtained this will be documented in writing.
3. If consent has been obtained, the exposed employee's blood will be tested.

The occupational physician will provide the employer with a confidential written opinion that includes verification that the employee has been informed of the results of the evaluation and also includes a recommendation for further evaluation or treatment. A copy of this written opinion will be provided within 15 days following the medical evaluation.

4.5.5.2 "Good Samaritan" Behavior

The OSHA standard does not cover "good samaritan" behavior. However, employees who provide first aid as "good samaritans" should receive the same post incident evaluation either through an EMR designated physician or their personal physician.

4.6 REFERENCES

OSHA Title 29 CFR Part 1910.1030

U.S. Department of Labor, U.S. Department of Health and Human Services. Joint Advisory Notice: protection against occupational exposure to Hepatitis B virus and human immunodeficiency virus. Federal Register 1987; 52:41818-24.

Centers for Disease Control. Update on hepatitis B prevention. MMWR 1987; 36:353-360,366.

Centers for Disease Control. Update: Acquired immunodeficiency syndrome and human immunodeficiency virus infection among health- care workers. MMWR 1988; 37:229-34, 239.

OSHA Instruction CPL 2-2.44, February 13, 1992, Enforcement Procedures for the Occupational Exposure to Bloodborne Pathogens Standard.

Appendix A

SUGGESTED BLOODBORNE PATHOGENS TRAINING OUTLINE

I. Introduction

- A. Purpose of the training program
- B. Overview: Bloodborne Pathogen Standard 29 CFR 1910.1030
  1. Applicability to Site Personnel
  2. General requirements
  3. Overview of Baker exposure control plan

II. Bloodborne Diseases

- A. Types
- B. Modes of Transmission

III. Baker Exposure Control Plan

- A. Purpose
- B. Plan availability
- C. Bloodborne pathogen hazard recognition steps
  1. Concept of universal precautions
  2. Blood and other potentially infectious materials
- D. Potential exposure minimization
  1. Work practices
  2. Personal protective equipment
  3. Hygienic practices
- E. Procedures for decontamination
  1. Personnel
  2. Personal protective equipment (PPE)
     - a. Tasks and procedures requiring PPE
     - b. Location of PPE
     - c. Disposal of PPE
  3. Equipment
  4. Work surfaces
- F. Medical monitoring
  1. Baker medical monitoring program
  2. Post exposure evaluation procedures
     - a. First aid incident report
     - b. HBV and non-HBV vaccinated responders
     - c. Exposure incidents (defined)
     - e. Confidential medical evaluation
- G. Emergency Preparedness
  1. First aid kits
  2. Personal injury

5.0 - HEAT STRESS

5.1 INTRODUCTION

Heat stress in the hazardous waste industry usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated temperatures. If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physiological reactions can occur, ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal.

5.2 CAUSES AND SYMPTOMS

The following heat stress causes and symptoms are provided for buddy monitoring purposes. Site personnel must realize that monitoring the physical condition of fellow personnel in Levels D+ through B protective ensembles will be more difficult.

1. *Heat rash* results from continuous exposure to heat or humid air and chafing clothes. The condition decreases the ability to tolerate heat. Symptoms include a mild red rash.

2. *Heat cramps* are caused by heavy sweating and inadequate fluid intake. Symptoms include muscle spasms and pain in the hands, feet, and abdomen.

3. *Heat exhaustion* occurs when body organs attempt to keep the body cool, due to inadequate fluid intake and personnel not acclimated to the environment. Symptoms include pale, cool, moist skin; heavy sweating; dizziness, headaches, and vomiting.

4. *Heat stroke* is the most serious form of heat stress. It is a MEDICAL EMERGENCY. Symptoms are red, hot, dry skin; lack of perspiration; nausea; dizziness and confusion; strong, rapid pulse rate; and coma.

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If *heat stroke* is noted or suspected, medical attention must be sought IMMEDIATELY. Efforts should be taken to cool the body to prevent serious injury or death.

5.3 PREVENTION

Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventive measures are vital. Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventive heat stress management. In general:

- Monitor for signs of heat stress.

- Fluid intake should be increased during rest schedules to prevent dehydration. Drinking cool water (maintained at 50 to 60°F) is satisfactory when light sweating occurs and temperatures are moderate to cool; however, diluted electrolyte solutions (i.e., Gatorade, Sqwincher, or equivalent) must be used in addition to water under one or all of the following conditions: continued or heavy sweating, moderate to high ambient temperatures, or heavy work loads. The intake of coffee during working hours is discouraged.

- Acclimate workers to site work conditions by slowly increasing workloads (i.e., do not begin site work activities with extremely demanding activities).
- Use cooling devices to aid natural body ventilation. These devices, however, add weight and their use should be balanced against worker efficiency. An example of a cooling aid is a cooling vest that can be worn under clothing, but not against the skin.
- In extremely hot weather, conduct field activities in the early morning and evening.
- Ensure that adequate shelter is available to protect personnel against heat that can decrease physical efficiency and increase the probability of both heat and cold stress. If possible, set up the command post in a shaded area, and encourage breaks in shaded areas.
- In hot weather, rotate shifts of workers wearing impervious clothing.
- Good hygienic standards must be maintained by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult the SHSO.

5.4 MONITORING

Provisions for monitoring for heat stress will be determined by the SHSO and performed as outlined below. Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

5.4.1 Monitoring for Permeable Clothing

For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If the actual clothing work differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

The guidelines to follow for workers above as determined by the SHSO are as follows:

1. Increased awareness of heat stress symptoms and buddy monitoring.
2. Fluid intake discipline.
3. Self monitoring of urine output quantities to prevent dehydration.
4. Attention to work-rest intervals.
5. Calculate the Heat Exposure Threshold Limit Value (TLV) for work-rest intervals using the following steps:

a. Determine the Wet Bulb Globe Temperature (WBGT) Index using the Quest® Heat Stress Monitor.

b. Estimate the work load using the following guidelines:

   (1) Light work = sitting or standing to control machines, performing light hand or arm work.

   (2) Moderate work = walking about with moderated lifting and pushing.

   (3) Heavy work = pick and shovel work.

c. Evaluate the calculations against the following Heat Exposure TLVs* in °C or (°F).

Work - Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous work	30.0 (86)	26.7 (80)	25.0 (77)
75% work - 25% rest, each hour	30.6 (87)	28.0 (82)	25.9 (78)
50% work - 50% rest, each hour	31.4 (89)	29.4 (85)	27.9 (82)
25% work - 75% rest, each hour	32.2 (90)	31.1 (88)	30.0 (86)

* For unacclimated workers, the permissible heat exposure TLV should be reduced by 2.5°C.

Special Considerations

- Acclimatization - After approximately one to two weeks, workers should be acclimated to their environment.
- Fitness - Physically fit workers will adjust more readily to a change in environment.
- Medication - Some medications can predispose individuals to heat-induced illnesses.

5.4.2 Semipermeable/Impermeable Clothing Monitoring

For workers wearing semipermeable or impermeable clothing encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70°F (21°C).

To monitor the worker, use one or more of the following methods:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
  - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
    - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
    - If oral temperatures still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
    - Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss. Measure weight on a scale accurate to ±0.25 pound at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or preferably in underwear only. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of work cycle will be governed by the frequency of the required physiological monitoring.

5.5 CARING FOR HEAT-RELATED ILLNESS

To care for heat-related illness provide the following:

- Remove victim from heat.
- Loosen tight clothing.
- Apply cool, wet cloths to the skin.
- Fan the victim.
- If victim is conscious, give cool water to drink.
- Call for an ambulance or transport to hospital if heat stroke is suspected, victim refuses water, vomits, or starts to lose consciousness.

6.0 - COLD STRESS

6.1 INTRODUCTION

The potential exists for either frostbite or hypothermia to occur when conducting work activities in an environment where air temperatures may fall below freezing or where wind-chill factors lower air temperatures below freezing. A brief description of the exposure symptoms (for both hypothermia and frostbite) and methods of prevention are listed in the sections below:

6.2 CAUSES AND SYMPTOMS

The following cold stress causes and symptoms are provided for buddy monitoring purposes. Site personnel must realize that monitoring the physical condition of fellow personnel in Levels D+ through B protective ensembles will be more difficult.

6.2.1 Frostbite

Frostbite is a condition in which there is a freezing or partial freezing of some part of the body. Individuals previously exposed to frostbite are more susceptible to contracting it again. Vasoconstrictors, which include tobacco products, constrict blood vessels, and can accelerate frostbite. The three stages of frostbite include: (1) frostnip - the beginnings of frostbite whereby the skin begins to turn white; (2) superficial - similar to frostnip except the skin begins to turn numb; and (3) deep - the affected area is frozen to the bone, cold, numb, and very hard.

DO NOT:

- Rub the frostbitten part.
- Use ice, snow, gasoline, or anything cold on the frostbitten area.
- Use heat lamps or hot water bottles to rewarm the frostbitten area.
- Place the frostbitten area near a hot stove.

6.2.2 Hypothermia

Hypothermia is a condition in which the body loses heat faster than it is produced. At a body temperature of 95°F, an average man is considered to be hypothermia. Vasodilators, which include alcohol and drugs, allow the body to lose heat faster which can accelerate hypothermia. The five stages of hypothermia include:

(1) shivering
(2) apathy, listlessness, or sleepiness
(3) unconsciousness, glassy stare, slow pulse or slow respiratory rate
(4) freezing of the extremities
(5) death

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If the latent conditions of hypothermia or frostbite are noted or suspected, medical attention must be sought IMMEDIATELY to prevent permanent injury or death.

6.3 PREVENTION

To prevent conditions from occurring have personnel:

- Dress in a minimum of three layers:

  (1) a skin layer to absorb moisture and keep skin dry
  (2) an insulating layer
  (3) an outer layer of nylon/wind-breaking material or chemical-protective layer

- Avoid touching cold surfaces (especially metal) with bare skin, minimize exposed skin surfaces.
- Keep active, use warm and dry shelter areas during rest cycles.
- Maintain body fluids.
- Use wind breaks whenever possible.

6.4 CARING FOR COLD-RELATED ILLNESS

The following lists the general guidelines to care for cold-related injuries:

- Start by treating any life-threatening problems.
- Call the local emergency number for help or transport the victim to the nearest hospital.
- Move the victim to a warm place, if possible.
- Remove any wet clothing and dry the victim.
- Warm the victim slowly by wrapping in blankets or putting on dry clothing.
- Apply other sources of heat if they are available.

6.5 MONITORING

In cold weather, monitor the outdoor temperature and wind speed to determine wind chill conditions, with work periods adjusted accordingly. The following table (developed by the U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts) details the wind chill effects and relative danger of combined cold and wind conditions.

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE

(under calm conditions)

	Actual Temperature Reading (°F)											
Estimated Wind Speed	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
(in mph)	*Equivalent Chill Temperature (°F)*											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In chr with dry skin Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.			GREAT DANGER Flesh may freeze within 30 seconds.				

Trenchfoot and immersion foot may occur at any point on this chart.

Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA..

Attachment B
Material Safety Data Sheets

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 300
Acetone

Issued: 11/77 Revision: F, 9/92

Section 1. Material Identification

Acetone (CH_3COCH_3) Description: Derived by the dehydrogenation or oxidation of isopropyl alcohol with a metallic catalyst, the oxidation of cumene, the vapor phase oxidation of butane; and as a by-product of synthetic glycerol production. Used as a solvent for paint, varnish, lacquer, fat, oil, wax, resin, rubber, plastic, and rubber cement; to clean and dry parts of precision equipment; in the manufacture of chemicals (methyl isobutyl ketone, methyl isobutyl carbinol, methyl methacrylate, bisphenol-A, acetic acid (ketene process), mesityl oxide, diacetone alcohol, chloroform, iodoform, bromoform), explosives, aeroplane dopes, rayon, photographic films, isoprene; acetylene gas storage cylinders; in purifying paraffin; in nail polish remover; in the extraction of various principles from animal and plant substances; in hardening and dehydrating tissues; in cellulose acetate (especially as spinning solvent); as a solvent for potassium iodide and permanganate; as a delusterant for cellulose acetate fibers; in the specification testing of vulcanized rubber products.

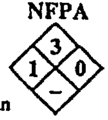
Other Designations: CAS No. 67-64-1, AI3-01238, Chevron acetone, dimethylformaldehyde, dimethylketal, dimethyl ketone, β-ketopropane, methyl ketone, propanone, 2-propanone, pyroacetic acid, pyroacetic ether.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Acetone vapor is a dangerous fire and explosion hazard. High vapor concentrations may produce narcosis (unconsciousness). Prolonged or repeated skin contact causes dryness, irritation, and mild dermatitis.

R 1
I 1
S 1*
K 3
* Slight skin absorption

NFPA



HMIS
H 1
F 3
R 0
PPE*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Acetone, 99.5% plus 0.5% water

1991 OSHA PELs *
8-hr TWA: 750 ppm (1800 mg/m^3)
15-min STEL: 1000 ppm (2400 mg/m^3)

1990 IDLH Level
20,000 ppm

1990 NIOSH REL
TWA: 250 ppm (590 mg/m^3)

1992-93 ACGIH TLVs
TWA: 750 ppm (1780 mg/m^3)
STEL: 1000 ppm (2380 mg/m^3)

1990 DFG (Germany) MAK
1000 ppm (2400 mg/m^3)
Category IV: Substances eliciting very weak effects (MAK >500 mL/m^3)
Peak: 2000 ppm, 60 min, momentary value†, 3 peaks/shift

1985-86 Toxicity Data ‡
Human, eye: 500 ppm
Human, inhalation, TC_{Lo}: 500 ppm produced olfaction effects, conjunctival irritation, and other changes involving the lungs, thorax, or respiration.
Rat, oral, LD_{50}: 5800 mg/kg altered sleep time and produced tremors.
Mammal, inhalation, TC_{Lo}: 31500 μg/m^3/24 hr administered to pregnant female from the 1st to 13th day of gestation produced effects on fertility (post-implantation mortality).

* In the cellulose acetate fiber industry, enforcement of the OSHA TWA for "doffers" was stayed on 9/5/89 until 9/1/90; the OSHA STEL *does not* apply to that industry.
† Momentary value is a level which the concentration should never exceed.
‡ See NIOSH, *RTECS* (AL3150000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 133.2 °F (56.2 °C) at 760 mm Hg
Freezing Point: -139.6 °F (-95.35 °C)
Vapor Pressure: 180 mm Hg at 68 °F (20 °C), 400 mm Hg at 103.1 °F (39.5 °C)
Saturated Vapor Density (Air = 1.2 kg/m^3, 0.075 lb/ft^3): 1.48 kg/m^3, .093 lb/ft^3
Refractive Index: 1.3588 at 20 °C
Appearance and Odor: Colorless, highly volatile liquid; sweetish odor.
Molecular Weight: 58.08
Specific Gravity: 0.7899 at 20 °C/4 °C
Water Solubility: Soluble
Other Solubilities: Alcohol, benzene, dimethyl formamide, chloroform, ether, and most oils.
Odor Threshold: 47.5 mg/m^3 (low), 1613.9 mg/m^3 (high)*

* Odor thresholds recorded as a range from the lowest to the highest concentration.

Section 4. Fire and Explosion Data

Flash Point: 0 °F (-18 °C), CC	**Autoignition Temperature:** 869 °F (465 °C)	**LEL:** 2.6% v/v	**UEL:** 12.8% v/v

Extinguishing Media: *Do not* extinguish fire unless flow can be stopped. For small fires, use dry chemical, carbon dioxide (CO_2), water spray or alcohol-resistant foam. For large fires, use water spray, fog, or alcohol-resistant foam. Use water in flooding quantities as fog because solid streams may be ineffective. **Unusual Fire or Explosion Hazards:** Acetone is a dangerous fire and explosion hazard; it is a Class IB flammable liquid. Vapors may travel to a source of ignition and flash back, fire-exposed containers may explode, and a vapor explosion hazard may exist indoors, outdoors, or in sewers. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides limited protection. If feasible, remove all fire-exposed containers. Otherwise, apply cooling water to sides of containers until well after fire is extinguished. If the fire becomes uncontrollable or container is exposed to direct flame, consider evacuation of a one-third mile radius. In case of rising sound from venting safety device or any discoloration of tank during fire, withdraw immediately. For massive cargo fires, use unmanned hose holder or monitor nozzles. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Acetone is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Acetone may form explosive mixtures with hydrogen peroxide, acetic acid, nitric acid, nitric acid + sulfuric acid, chromic anhydride, chromyl chloride, nitrosyl chloride, hexachloromelamine, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, thiodiglycol + hydrogen peroxide. Acetone reacts vigorously with oxidizing materials and ignites on contact with activated carbon, chromium trioxide, dioxygen difluoride + carbon dioxide, and potassium-*tert*-butoxide. Other incompatibles include air, bromoform, bromine, chloroform + alkalies, trichloromelamine, and sulfur dichloride. **Conditions to Avoid:** Keep acetone away from plastic eyeglass frames, jewelry, pens, pencils, and rayon garments. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of acetone can produce CO_2 and carbon monoxide (CO).

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list acetone as a carcinogen. **Summary of Risks:** Acetone has been placed among solvents of comparatively low acute and chronic toxicities. In industry, the most common effects reported are headache from prolonged vapor inhalation and skin irritation resulting from its defatting action. Exposures to less than 1000 ppm acetone vapor produces only slight eye, nose, and throat irritation. Acetone does not have sufficient warning properties to prevent repeated exposures. It is narcotic at high concentrations, i.e., above 2000 ppm. Concentrations above 12000 ppm cause loss of consciousness.

Continue on next page

Section 6. Health Hazard Data, *continued*

Medical Conditions Aggravated by Long-Term Exposure: None reported. **Target Organs:** Respiratory and central nervous systems, skin. **Primary Entry Routes:** Inhalation, skin and eye contact, ingestion. Liquid acetone is slowly absorbed through the skin. **Acute Effects:** Human systemic effects by inhalation include eye, nose and throat irritation; nausea and vomiting; changes in EEG (electroencephalogram) and carbohydrate metabolism; muscle weakness; drunken behavior; mental confusion and visual disturbance. In extreme cases, breathing high concentrations may produce coma. Human systemic effects by ingestion include gastrointestinal irritation, kidney damage (often indicated by albumin and red and white blood cells in the urine), liver damage (indicated by high levels of urobilin and early appearance of bilirubin), coma, metabolic changes, and systemic effects described for inhalation. Direct eye contact by liquid acetone may produce painful burning and stinging; watering of eyes; conjuctival inflammation; and corneal injury. Skin contact produces a cold feeling, dryness, and mild irritation.

Chronic Effects: Cases of chronic poisoning resulting from prolonged exposure to low concentrations of acetone are rare. Workers exposed to 1000 ppm, 3 hrs per day for 7-15 yrs, complained of dizziness, asthenia (lack or loss of strength), and chronic inflammation of the airways, stomach, and duodenum. Prolonged or repeated skin contact with liquid acetone may defat the skin and cause eczematoid dermatitis.

FIRST AID

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Carefully dispose of contaminated clothing because it may pose a fire hazard. **Inhalation:** Remove exposed person to fresh air, monitor for respiratory distress, and administer 100% humidified supplemental oxygen as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. **After first aid, get appropriate in-plant, paramedic, or community medical support.**

Note to Physicians: In symptomatic patients, monitor serum and urine acetone, fluid intake, blood glucose, and arterial pH. Because of the prolonged elimination half-life of acetone, the symptomatic patient may need medical supervision for many hours (up to 30 hrs). Patients may develop hyperglycemia and ketosis mimicking acute diabetic coma. The hyperglycemia may persist for several days following acute exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against inhalation and skin or eye contact. If feasible and without risk, stop leak. Use water spray to reduce vapor, but it may not prevent ignition in closed spaces. For small spills, take up with sand or other noncombustible absorbent material and using nonsparking tools, place into containers for later disposal. For large spills, dike far ahead of liquid spill for later disposal. Do not release to sewers or waterways. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Toxicity:** LC_{50} *Salmo gairdneri* (rainbow trout): 5540 mg/L/96 hr at 54 °F (12 °C). LC_{50} (oral) Ring-necked pheasant: >40,000 ppm. **Environmental Degradation:** Acetone biodegrades when released into the environment. The biological oxygen demand for 5 days (BOD5) is 46-55%. **Soil Absorption/Mobility:** Acetone volatilizes, leaches, and biodegrades if released on soil. **Disposal:** Acetone is a good candidate for fluidized bed, rotary kiln incineration, or catalytic oxidation. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33): Hazardous Waste No. U002 (Ignitability), (40 CFR 261.31): F003 (spent solvent)

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 5000 lb (2270 kg) [* per Clean Water Act, Sec. 311(b)(4)]

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations < 1000 ppm, wear any chemical cartridge respirator with organic vapor cartridge(s) and wear eye protection to avoid irritation or damage. For concentrations <6250 ppm, wear any supplied-air respirator operated in a continuous-flow mode. For concentrations < 12,500 ppm, wear any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister. For concentrations < 20,000 ppm, wear any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Polyethylene/ethylene vinyl alcohol, Teflon, or butyl rubber with breakthrough times > 8 hr is recommended for PPE. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry well-ventilated area away from heat, sparks, flames, and other incompatibles. Keep large stocks away from inhabited buildings. Use non-sparking tools to open containers. Keep dry chemical or CO_2 extinguishers on hand in case of fire. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. To prevent static sparks, electrically ground and bond all containers and equipment during fluid transfer. For bulk storage rooms, install electrical equipment, Class I, Group D. **Administrative Controls:** Consider preplacement and periodic medical examinations with emphasis on the skin and respiratory tract. Also consider liver and kidney function tests and urinalysis.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Acetone	**Packaging Authorizations**	**Quantity Limitations**	**Vessel Storage Requirements**
DOT Hazard Class: 3	**a) Exceptions:** 173.150	**a) Passenger, Aircraft, or Railcar:** 5L	**Vessel Stowage:** B
ID No.: UN1090	**b) Non-bulk Packaging:** 173.202	**b) Cargo Aircraft Only:** 60L	**Other:** --
DOT Packaging Group: II	**c) Bulk Packaging:** 173.242		
DOT Label: Flammable Liquid			
Special Provisions (172.102): T8			

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 176, 180

Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** AC Darlington, MPH, MD

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 316
Benzene

Issued: 11/78 **Revision: E, 8/90**

Section 1. Material Identification

32

Benzene (C_6H_6) Description: Derived by fractional distillation of coal tar, hydrodealkylation of toluene or pyrolysis of gasoline, catalytic reforming of petroleum, and transalkylation of toluene by disproportionation reaction. Used as a fuel; a chemical reagent; a solvent for a large number of materials such as paints, plastics, rubber, inks, oils, and fats; in manufacturing phenol, ethylbenzene (for styrene monomer), nitrobenzene (for aniline), dodecylbenzene (for detergents), cyclohexane (for nylon), chlorobenzene, diphenyl, benzene hexachloride, maleic anhydride, benzene-sulfonic acid, artificial leather, linoleum, oil cloth, varnishes, and lacquers; for printing and lithography; in dry cleaning; in adhesives and coatings; for extraction and rectification; as a degreasing agent; in the tire industry; and in shoe factories. Benzene has been banned as an ingredient in products intended for household use and is no longer used in pesticides.

Other Designations: CAS No. 0071-43-2, benzol, carbon oil, coal naphtha, cyclohexatriene, mineral naphtha, nitration benzene, phene, phenyl hydride, pyrobenzol.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 4
S 2*
K 4
*Skin absorption

NFPA
3
2 0
-

HMIS
H 3
F 3
R 0
PPG†
† Sec. 8

Cautions: Benzene is a confirmed *human carcinogen* by the IARC. *Chronic low-level exposure may cause cancer (leukemia) and bone marrow damage, with injury to blood-forming tissue.* It is also a dangerous fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Benzene, ca 100%*

1989 OSHA PELs
(29 CFR 1910.1000, Table Z-1-A)
8-hr TWA: 1 ppm, 3 mg/m³
15-min STEL: 5 ppm, 15 mg/m³

(29 CFR 1910.1000, Table Z-2)
8-hr TWA: 10 ppm
Acceptable Ceiling Concentration: 25 ppm
Acceptable Maximum Peak: 50 ppm (10 min)†

1989-90 ACGIH
TLV-TWA: 10 ppm, 32 mg/m³

1988 NIOSH RELs
TWA: 0.1 ppm, 0.3 mg/m³
Ceiling: 1 ppm, 3 mg/m³

1985-86 Toxicity Data‡
Man, oral, LD_{Lo}: 50 mg/kg; no toxic effect noted
Man, inhalation, TC_{Lo}: 150 ppm inhaled intermittently over 1 yr in a number of discrete, separate doses affects the blood (other changes) and nutritional and gross metabolism (body temperature increase)
Rabbit, eye: 2 mg administered over 24 hr produces severe irritation

* OSHA 29 CFR 1910.1000, Subpart Z, states that the final benzene standard in 29 CFR 1910.1028 applies to all occupational exposures to benzene except in some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.

† Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift.

‡ See NIOSH, *RTECS* (CY1400000), for additional irritative, mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 176 °F (80 °C)
Melting Point: 42 °F (5.5 °C)
Vapor Pressure: 100 mm Hg at 79 °F (26.1 °C)
Vapor Density (Air = 1): 2.7
Evaporation Rate (Ether = 1): 2.8
Molecular Weight: 78.11
Specific Gravity (15 °C/4 °C): 0.8787
Water Solubility: Slightly (0.180 g/100 g of H_2O at 25 °C)
% Volatile by Volume: 100
Viscosity: 0.6468 mPa at 20 °C

Appearance and Odor: A colorless liquid with a characteristic sweet, aromatic odor. The odor recognition threshold (100% of panel) is approximately 5 ppm (unfatigued) in air. Odor *is not* an adequate warning of hazard.

Section 4. Fire and Explosion Data

Flash Point: 12 °F (-11.1 °C), CC	**Autoignition Temperature:** 928 °F (498 °C)	**LEL:** 1.3% v/v	**UEL:** 7.1% v/v

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to extinguish benzene fires. Water may be ineffective as an extinguishing agent since it can scatter and spread the fire. Use water spray to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.

Unusual Fire or Explosion Hazards: Benzene is a Class 1B flammable liquid. A concentration exceeding 3250 ppm is considered a potential fire explosion hazard. Benzene vapor is heavier than air and can collect in low lying areas or travel to an ignition source and flash back. Explosive and flammable benzene vapor-air mixtures can easily form at room temperature. Eliminate all ignition sources where benzene is used, handled, or stored.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Structural firefighter's protective clothing provides limited protection. Stay out of low areas. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Runoff to sewer can create pollution, fire, and explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Benzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Benzene explodes on contact with diborane, permanganic acid, bromine pentafluoride, peroxodisulfuric acid, and peroxomonosulfuric acid. It ignites on contact with dioxygen difluoride, dioxygenyl tetrafluoroborate, iodine heptafluoride, and sodium peroxide + water. Benzene forms sensitive, explosive mixture with iodine pentafluoride, ozone, liquid oxygen, silver perchlorate, nitryl perchlorate, nitric acid, and arsenic pentafluoride + potassium methoxide (explodes above 30 °C). A vigorous or incandescent reaction occurs with bromine trifluoride, uranium hexafluoride, and hydrogen + Raney nickel [above 410 °F (210 °C)]. Benzene is incompatible with oxidizing materials.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of benzene can produce toxic gases and vapors such as carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The ACGIH, OSHA, and IARC list benzene as, respectively, a supected human carcinogen, a cancer hazard, and, based on sufficient human and animal evidence, a human carcinogen (Group 1).

Summary of Risks: Prolonged skin contact or excessive inhalation of benzene vapor may cause headache, weakness, appetite loss, and fatigue. The most important health hazards are cancer (leukemia) and bone marrow damage with injury to blood-forming tissue from chronic low-level exposure. Higher level exposures may irritate the respiratory tract and cause central nervous system (CNS) depression.

Medical Conditions Aggravated by Long-Term Exposure: Exposure may worsen ailments of the heart, lungs, liver, kidneys, blood, and CNS.

Target Organs: Blood, central nervous system, bone marrow, eyes, upper respiratory tract, and skin.

Primary Entry Routes: Inhalation, skin contact.

Acute Effects: Symptoms of acute overexposure include irritation of the eyes, nose, and respiratory tract, breathlessness, euphoria, nausea, drowsiness, headache, dizziness, and intoxication. Severe exposure may lead to convulsions and unconsciousness. Skin contact may cause a drying rash (dermatitis).

Chronic Effects: Long-term chronic exposure may result in many blood disorders ranging from aplastic anemia (an inability to form blood cells) to leukemia.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Immediately rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air. Emergency personnel should protect against inhalation exposure. Provide CPR to support breathing or circulation as necessary. Keep awake and transport to a medical facility.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* since aspiration may be fatal. Call a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Physician's Note: Evaluate chronic exposure with a CBC, peripheral smear, and reticulocyte count for signs of myelotoxicity. Follow up any early indicators of leukemia with a bone marrow biopsy. Urinary phenol conjugates may be used for biological monitoring of recent exposure. Acute management is primarily supportive for CNS depression.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a benzene spill control and countermeasure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against vapor inhalation, eye contact, and skin absorption. Absorb as much benzene as possible with an inert, noncombustible material. For large spills, dike far ahead of spill and contain liquid. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of confined spaces such as sewers, watersheds, and waterways because of explosion danger. Follow applicable OSHA regulations (29 CFR 1910.120).

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U019

Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1000 lb (454 kg) [* per Clean Water Act, Sec. 307 (a), 311 (b)(4), 112; and per RCRA, Sec. 3001]

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

Listed as SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Tables Z-1-A and Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations at least below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all heat and ignition sources and incompatible materials. *Caution! Benzene vapor may form explosive mixtures in air.* To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. When opening or closing benzene containers, use nonsparking tools. Keep fire extinguishers readily available.

Engineering Controls: Because OSHA specifically regulates benzene (29 CFR 1910.1028), educate workers about its potential hazards and dangers. Minimize all possible exposures to carcinogens. If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if absolutely essential. Avoid vapor inhalation and skin and eye contact. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Designate regulated areas of benzene use (see legend in the box below) and label benzene containers with "DANGER, CONTAINS BENZENE, CANCER HAZARD."

Other Precautions: Provide preplacement and periodic medical examinations with emphasis on a history of blood disease or previous exposure.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Benzene (*benzol*)
DOT Hazard Class: Flammable liquid
ID No.: UN1114
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Benzene
IMO Hazard Class: 3.2
ID No.: UN1114
IMO Label: Flammable liquid
IMDG Packaging Group: II

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE–NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

MSDS Collection References: 1, 2, 12, 26, 73, 84-94, 100, 101, 103, 109, 124, 126, 127, 132, 134, 136, 138, 139, 143

Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 68
Calcium Hypochlorite

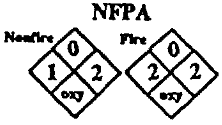
Issued: 7/80 **Revision: A, 11/89**

Section 1. Material Identification 30

Calcium Hypochlorite Description: Calcium hypochlorite dihydrate precipitates from chlorinated lime slurry and caustic soda and is dried under vacuum to produce calcium hypochlorite. Used as a disinfectant (for swimming pools), bleaching agent (paper towels), fungicide, deodorant, oxidizing agent, bactericide, and algicide; in sugar refining and potable water purification.
Other Designations: Calcium oxychloride (improperly called); losantin; hypochlorous acid; calcium salt; HTH® (high-test hypochlorite); lime chloride; $Ca(OCl)_2$; CAS No. 7778-54-3.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.

R	1
I	-
S	3
K	-

NFPA



HMIS		HMIS	
H	1	H	2
F	0	F	0
R	2	R	2
PPG*		PPG*	

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Calcium hypochlorite*

OSHA PEL	ACGIH TLV, 1988-89	NIOSH REL, 1987	Toxicity Data
None established	None established	None established	Rat, oral, LD_{50}: 850 mg/kg

* Concentration is usually stated in terms of weight % of available chlorine (see *ASTM* D2022). This material contains 39% or less available chlorine. Calcium hypochlorite mixture, dry, contains more than 39% available chlorine. HTH® contains about 70% available chlorine. Solid materials with less than 39% available chlorine include chloride of lime and bleaching powder, which contain much chloride ion, water, and possibly other impurities, for example, $Ca(OCl)Cl \cdot 2H_2O$. The presence of magnesium hypochlorite in material of high available chlorine level may reduce its stability.

Section 3. Physical Data

Boiling Point: None reported
Melting Point: Decomposes at 212 °F (100 °C)
Molecular Weight: 142.98 g/mol
Specific Gravity (H_2O = 1 at 39 °F (4 °C)): 2.35
Water Solubility: Soluble

Appearance and Odor: White nonhygroscopic (doesn't absorb moisture from the air) granules or tablets with a strong chlorine odor.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use a water spray to cool fire-exposed containers of this material and *drench* the area with large amounts of water from a safe position. *Never use* a dry chemical or CO_2.
Unusual Fire or Explosion Hazards: When heated in a fire situation, containers can rupture violently! Contaminating or mixing calcium hypochlorite with foreign materials (combustibles, grease, chemicals, fuels) can cause fires of great intensity. Its solid form is moderately explosive when heated.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Full protective clothing is also necessary. Fight massive fires using unmanned hose holders. If this is impossible, let fire burn and withdraw from hazardous areas.

Section 5. Reactivity Data

Stability/Polymerization: Calcium hypochlorite is stable at room temperature in suitable closed containers when kept dry and free from contamination. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Calcium hypochlorite is a powerful oxidizing agent that readily ignites combustibles. Violent reactions or explosions can occur, for example, with amines, carbon tetrachloride and heat, carbon or charcoal and heat, ethyl alcohol, metal oxides, mercaptons, sulfur, turpentine, strong reducing agents, organic matter, combustible materials, nitromethane, ammonium chloride, N,N-dichloromethylamine and heat, acetic acid and potassium cyanide, ethanol, isobutanethiol, methanol, 1-pro-panethiol, and rust. Reacts with water or steam to produce toxic and corrosive fumes or HCl and Cl^- (Sec. 6). Potentially explosive with sodium carbonate, starch, and sodium hydrogen sulfate. Reaction with nitrogenous bases or acetylene forms explosive products. Ignites on contact with glycerine algacide and hydroxy compounds (e.g., glycerol, diethylene glycol monomethyl ether, and phenol), and organic sulfur compounds. Material containing over 60% available chlorine ignites on contact with lubricating oil (addition of about 20% or more water prevents this). On contact with acids it forms hypochlorous acid and liberates Cl_2 gas. It forms the highly explosive NCl_3 with urea.
Hazardous Products of Decomposition: Rapid exothermic (heat-producing) decomposition above 347 °F(175 °C) releases oxygen and chlorine. When heated to decomposition, calcium hypochlorite emits highly toxic hydrochloric acid (HCl) fumes and explodes. .

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists calcium hypochlorite as a carcinogen.
Summary of Risks: This strong oxidizing agent can irritate and damage all the tissue it contacts, with the degree of injury depending on the dose, available chlorine level, and exposure time. The chlorine this compound generates is the primary toxic agent. Both the powder and solutions produce chlorine levels corrosive to body tissues. Inhaling its vapor is extremely irritating and toxic. Possible injuries include: conjunctivitis, blepharitis (inflammation of the margins of the eyelids), corneal ulcerations, gingivitis, contact dermatitis, and tooth damage. **Medical Conditions Aggravated by Long-Term Exposure:** Repeated contact can severely damage tissue. **Target Organs:** Skin, eyes, respiratory system, stomach. **Primary Entry:** Inhalation, ingestion. **Acute Effects:** Skin contact can produce irritation and vesicular eruptions. Dust inhalation irritates the respiratory tract and may cause pulmonary edema. Ingestion irritates the mouth, throat, and stomach, and gastric acid liberates hypochlorous acid. Fatalities can result from severe complications of local injury, shock, toxemia, hemorrage, wall perforation, and obstruction.
Chronic Effects: Eczematoid dermatitis may result from repeated skin contact. Eye contact can cause severe eye damage.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: After rinsing affected area with flooding amounts of water, wash it with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. If ingested, promptly rinse mouth of conscious person with water before giving large amounts of milk or water to drink, followed by milk of magnesia.
After first aid, get appropriate in-plant, paramedic, or community medical attention and support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spills. Remove combustibles and ignition sources. Those involved in cleanup need protection against contact with the solid and dust inhalation. Prevent dust generation and prevent direct discharge into sewers or waterways since this material, in low concentrations, is toxic to aquatic life. Recover uncontaminated solid material in clean, dry containers. Cover other spilled material with weak reducing agents (3M H_2SO_4 with bisulfites or ferrous salts), slurry it with water, and then flush it with water to a suitable holding tank. Wash spill site well with soap solution containing a weak reducing agent.
Disposal: Use reducing agents to destroy available chlorine. Adjust this reduced liquid's pH to neutral and decant. Discharge neutral liquid, diluting with much water. Dispose of neutral sludge (if any) in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 10 lb (4.54 kg) [* per Clean Water Act, Sec. 311(b)(4)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Wear a NIOSH-approved respirator if necessary. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. Use a dust respirator as required for dusty conditions.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious neoprene gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 103).
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store away from combustible and incompatible materials (Sec. 5) in closed containers in a cool, dry, well-ventilated low fire-risk area. Since traces of water may ignite or detonate this material, prevent contamination and protect containers from physical damage. Do not drop, roll, or skid containers.
Engineering Controls: Calcium hypochlorite, a powerful oxidizing agent, is a dangerous fire hazard when it contacts organic materials. Mix it only with water. These water solutions are unstable, but undergo a slow decomposition. Proper storage and shipping are essential; separate this material from ammonium compounds and heat sources.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Calcium hypochlorite mixture, dry (containing more than 39% available chlorine)
DOT Hazard Class: Oxidizer
ID No.: UN1748
DOT Label: Oxidizer
DOT Packaging Requirements: 49 CFR 173.217
DOT Packaging Exceptions: 49 CFR 173.153

IMO Shipping Name: Calcium hypochlorite mixtures, dry, with more than 39%, available chlorine (8.8% available oxygen)
IMO Hazard Class: 5.1
IMO Label: Oxidizer
IMDG Packaging Group: 2

MSDS Collection References: 1, 81, 84, 85, 90, 91, 101, 109, 126
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** Warren Silverman, MD M7

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 410
Carbon Tetrachloride

Issued: 12/80 Revision: B, 4/90

Section 1. Material Identification

31

Carbon Tetrachloride Description: A chlorinated hydrocarbon derived from interacting carbon disulfide and chlorine in the presence of iron, or chlorination of methane or higher hydrocarbons at 482 °F/250 °C to 752 °F/400 °C. Carbon tetrachloride is treated with caustic alkali solution to remove sulfur chloride. Its primary use is in manufacturing flurocarbon propellants. It is also used in producing of semiconductors, chlorinating organic compounds, metal degreasing, refrigerants; as a solvent for oils, fats, resins, rubber waxes, lacquers, and varnishes; and as an agricultural fumigant. This material was widely used in the dry-cleaning industry.

Other Designations: CAS No. 0056-23-5; CCl_4; carbon chloride; carbon tet; methane tetrachloride; perchloromethane; tetrachlorocarbon; tetrachloromethane.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 4
S 2*
K 0
*Skin absorption

NFPA

HMIS
H 3
F 0
R 0
PPG†
† Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Carbon tetrachloride, ca 100%

OSHA PEL
8-hr TWA: 2 ppm, 12.6 mg/m³

ACGIH TLV (Skin), 1989-90
TLV-TWA: 5 ppm, 31 mg/m³

NIOSH REL, 1987
60-min ceiling: 2 ppm, 12.6 mg/m³

Toxicity Data*
Rat, oral, LD$_{50}$: 2800 mg/kg; toxic effects not yet reviewed
Rat, inhalation, LC$_{50}$: 8000 ppm over 4 hr; no toxic effect noted
Human, inhalation, TC$_{Lo}$: 20 ppm inhaled produces gastrointestinal effects (nausea or vomiting)

* See NIOSH, *RTECS* (FG4900000), for additional irritative, mutative, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 169.77 °F/76.54 °C
Melting Point: -9.4 °F/-23 °C
Vapor Pressure: 91.3 mm Hg at 68 °F/20 °C
Vapor Density (Air = 1): 5.32
Molecular Weight: 153.84 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 1.5940 at 68 °F/20 °C
Water Solubility: Very slightly soluble (800 mg/l at 68 °F/20 °C)
Evaporation Rate (Butyl Acetate = 1): 12.8

Appearance and Odor: A colorless liquid with a heavy ethereal odor. The high and low odor thresholds are, respectively, 128.4 and 60 mg/m³. Odor is not an adequate warning sign to prevent overexposure.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Carbon tetrachloride is nonflammable and will not support combustion. Use extinguishing media appropriate to the surrounding fire. This material was previously used as an extinguishing medium in portable fire extinguishers, but its toxicity and fire decomposition products lead to its replacement with "safer" extinguishing media.

Unusual Fire or Explosion Hazards: Carbon tetrachloride can react violently with hot or burning metals such as aluminum and magnesium.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and fully encapsulating suit. Use water spray to cool fire-exposed containers. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Carbon tetrachloride is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Carbon tetrachloride reacts violently with fluorine gas, alkali metals, and aluminum (see reference 126 for specific incompatibilities).

Conditions to Avoid: This material has caused explosions when used as a fire extinguisher on wax fires and uranium fires. It may also form toxic phosgene when used to put out electrical fires.

Hazardous Products of Decomposition: Thermal oxidative decomposition of carbon tetrachloride can produce toxic phosgene and hydrogen chloride.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and ACGIH list carbon tetrachloride as an anticipated human carcinogen, a possible human carcinogen, and a suspected human carcinogen, respectively.
Summary of Risks: Carbon tetrachloride is highly toxic and irritating by inhalation, ingestion (mean lethal dose is 5 to 10 ml), and skin absorption. Alcohol's synergistic effects markedly increase CCl_4's toxicity. Excessive exposure may result in central nervous system depression, cardiac arrhythmias, and gastrointestinal symptoms. In humans the majority of fatalities have been the result of renal injury with secondary cardiac failure. Kidney and liver damage can occur from severe acute or chronic exposure. Human liver damage occurs more often after ingestion of the liquid than after the inhalation of the vapor. However, after a 30 min to 1 hr exposure to concentrations of 1000 to 2000 ppm, humans have died from acute renal damage.
Medical Conditions Aggravated by Long-Term Exposure: Prolonged recovery and permanent disability of the liver, kidney, and lungs are possible.
Target Organs: Central nervous system, eyes, skin, liver, kidneys, lungs.
Primary Entry Routes: Inhalation, percutaneous (through the skin).
Acute Effects: Acute exposure symptoms include eye, nose, skin, and throat irritation; cough, dyspnea, cyanosis, cardiac arrhythmias, headaches, dizziness, mental confusion, nausea, vomiting, abdominal pain, and diarrhea. Jaundice and abnormal liver enlargement accompanied by oliguria (reduced excretion of urine), proteinuria (protein in urine), and hematuria (blood in urine) may occur even after several days delay.
Chronic Effects: Chronic exposure symptoms include defatting dermatitis, headaches, dizziness, mental confusion, apathy, anorexia, nausea, vomiting, abdominal pain, weight loss, narrowing of visual field, optic nerve damage with possible blindness, hearing loss, and renal and hepatic decompensation (loss of these organs' ability to correct dysfunction). Chronic exposure may result in the development of aplastic anemia.

FIRST AID

Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Give one to two glasses of water to dilute and induce vomiting, unless the person shows evidence of decreasing mental functioning and awareness.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: To minimize hepatorenal damage, consider intravenous acetylcysteine. Hyperbaric oxygen is also utilized for significant exposures. Dialysis has also been suggested in severe cases. Give cardiorespiratory support as indicated and carefully monitor fluid and electrolytes. Closely monitor hepatic and renal functions. Avoid epinephrine because of myocardial sensitization and potential for inducing ventricular arhythymias.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area, and provide maximum exhaust ventilation. Cleanup personnel should protect against inhalation and skin and eye contact. Small spills can be absorbed on paper or some noncombustible, inert ingredient and allowed to evaporate in a hood. For large spills, dike far ahead to contain spill for disposal. Prevent release of CCl_4 to surface water or sewers. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33)
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 5000 lb (2270 kg) [* per RCRA, Sec. 3001, per Clean Water Act, Sec. 307(a), 311 (b)(4)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-2)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl alcohol protective gear is recommended.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL, ACGIH TLV, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed container in a cool, dry, well-ventilated, low fire-risk area away from incompatible materials (Sec. 5), direct sunlight, and heat. Prevent exposure of vapors to high temperature to prevent decomposition to toxic and corrosive gases and vapors.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Use only with adequate ventilation and appropriate personal protective gear. Monitor vapor levels and institute a respiratory protection program which includes training, maintenance, inspection, and evaluation. Practice good personal hygiene procedures. When possible, substitute a less hazardous solvent for CCl_4. Provide preplacement and biannual medical exams, including studies of liver and kidney function. Prevent exposing individuals with liver, kidney, or central nervous system diseases, or alcoholism. Alcohol's synergistic effects markedly increase CCl_4's toxicity.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Carbon tetrachloride
DOT Hazard Class: ORM-A
ID No.: UN1846
DOT Label: None
DOT Packaging Requirements: 173.620
DOT Packaging Exceptions: 173.505

IMO Shipping Name: Carbon tetrachloride
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1846

MSDS Collection References: 7, 26, 38, 53, 73, 84, 85, 88, 89, 100, 103, 109, 124, 126, 127, 129, 130, 131, 134, 136, 137
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD

MS

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 603

2-CHLOROACETOPHENONE

Issued: May 1986

SECTION 1. MATERIAL IDENTIFICATION

21

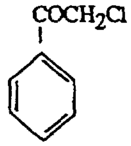
MATERIAL NAME: 2-CHLOROACETOPHENONE

OTHER DESIGNATIONS: alpha-Chloroacetophenone, Chloro Methyl Phenyl Ketone, Mace, Phenacyl Chloride, Phenylchloromethyl Ketone, Phenyl Chloromethyl Ketone, C_8H_7ClO, CAS #0532-27-4.

MANUFACTURER/SUPPLIER:
Haarmann & Reimer Corp., Aroma Chemical Div., PO Box 175,
111 US Hwy. 22, N. Springfield, NJ 07081; Telephone: (201) 686-3132

HMIS
H: 2
F: 1
R: 1
PPE*
*See Sect. 8

R 1
I 4
S 3
K 1

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
2-Chloroacetophenone, CAS #0532-27-4 COCH$_2$Cl  * Current (1985-86) ACGIH TLV or OSHA PEL.	ca 100	8-hr. TWA: 0.05 ppm or 0.3 mg/m^3* Rat, Oral, LD$_{50}$: 127 mg/m^3 Human, Inhalation, LCLo: 159 mg/m^3/20 min. Human, Inhalation, TCLo: 20 mg/m^3: Irritation Rabbit, Eye: 3 mg, Severe

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm ... 477°F (247°C)
Vapor Pressure @ 20°C, mm Hg ... 0.012
Water Solubility @ 20°C ... Insoluble
Vapor Density (Air = 1) ... 5.32
Evaporation Rate ... Not Found

Specific Gravity (H_2O = 1) ... 1.324
Melting Point ... 138°F (59°C)
Percent Volatile by Volume ... ca 100
Molecular Weight ... 154.60

Appearance and odor: Colorless-to-gray crystalline solid with a sharp, irritating floral odor. The odor threshold for 2-chloroacetetophenone is 0.1 mg/m^3.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
244°F (118°C) CC	Not Found	Not Found	–	–

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, foam, water fog. Water or foam may cause frothing. Use water spray to cool tanks/containers exposed to fire.

This OSHA class IIIB combustible liquid is a slight fire hazard when exposed to heat, sparks, or open flame. When involved in a fire, 2-chloroacetophenone emits toxic and corrosive vapors.
Fire fighters should use self-contained breathing apparatus and fully protective clothing when fighting fires involving this material.

SECTION 5. REACTIVITY DATA

2-Chloroacetophenone is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

This material is incompatible with strong oxidizers. It reacts slowly with water or steam, generating hydrogen chloride.

Thermal decomposition or burning produces toxic vapors and gases such as carbon monoxide and fumes of chlorine.

SECTION 6. HEALTH HAZARD INFORMATION

2-Chloroacetophenone is not listed as a carcinogen by the NTP, IARC, or OSHA.
This material is a potent irritant and lacrimator (promotes tears). It is highly toxic by inhalation and ingestion. Symptoms of overexposure include tingling in the nose, lacrimation, burning of and/or pain in the eyes, blurred vision, rhinorrhea, burning in the chest, difficulty in breathing, and nausea. In extreme cases pulmonary congestion and edema may result, with onset of edema appearing several hours to days after exposure. Humans exposed to levels of 200 to 340 mg/m^3 could not tolerate exposure for more than 30 seconds. 2-Chloroacetophenone is irritating to the skin and intensely irritating to the eyes. Overexposure of eyes can cause severe conjunctivitis; corneal haziness; pain; and, in severe cases, permanent partial opacity (leukoma). Contact with the skin may cause a burn, especially if the skin is moist or wet. It can also cause dermatitis and skin sensitization. The TLV of 0.05 ppm is set to prevent lacrimation and irritation. The irritation threshold for 2-chloroacetophenone ranges from 0.15 to 0.4 mg/m^3, while the lacrimation threshold is 0.3 to 0.4 mg/m^3. No chronic effects are reported. FIRST AID: EYE CONTACT: Promptly flush eyes, including under the eyelids, with running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Promptly flush skin with running water for at least 15 minutes while removing contaminated clothing and shoes. Get medical help if irritation persists.* INHALATION: Remove victim to fresh air. Restore and/or support his breathing as required. Keep him/her warm and quiet. Observe victim for symptoms of pulmonary edema. Get medical help.* INGESTION: Give victim 1 or 2 glasses of water or milk to drink as quickly as possible. Contact a physician or poison control center. Do not induce vomiting unless directed to do so. Never give anything by mouth to someone who is unconscious or is convulsing.*

GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large 2-chloroacetophenone spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate the spill area and limit access to necessary personnel only. Remove any leaking containers to a safe place, if feasible. Those involved in cleanup need protection against contact with the solid form and inhalation of dust and vapor (see sect. 8).

Scoop, shovel, or vacuum spilled material into closed containers. Use caution to avoid generating dust. Flush spill area with water and collect flushings and waste water for disposal. Do not flush waste to a sewer, watershed, or waterway.

Place waste in a suitable container for disposal by a licensed contractor, dispose of it in a landfill, or dissolve it in an organic solvent and burn it in an approved incinerator equipped with an afterburner and a scrubber. Follow all Federal, state, and local regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be nonsparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 lfm (linear feet per minute). For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved respirator.

Impervious gloves, face shield, apron, boots, plastic coveralls, and other protective clothing and equipment should be available and worn as necessary to prevent contact with skin or clothing. Wear safety goggles to prevent any possibility of 2-chloroacetophenone coming in contact with the eyes. Remove contaminated clothing immediately and do not wear it again until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store 2-chloroacetophenone in closed containers in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, and open flame. Storage area must be suitable for combustible solids. Protect containers from physical damage. Ground and bond conveying equipment and storage containers when transferring the solid to prevent the possibility of a dust explosion. Any bulk storage system should have an explosion-relief design. Do not smoke in use or handling areas. Use only with adequate ventilation. Avoid inhalation of dust and vapor and contact with skin, eyes, and clothing. Practice good industrial hygiene when handling this material. Avoid generating dust. Emptied containers retain product residues; handle them accordingly!

Preplacement and periodic physical examinations should be provided to those who work with this material. Individuals with histories of chronic respiratory, skin, or eye disease may be at increased risk from exposure.

DOT Classification: Irritating Material. DOT No. UN1697

Data Source(s) Code: 2, 4, 5, 7, 8, 23, 34, 47, 63, 69, 75, 78, 79-82. CR

Approvals	
Indust. Hygiene/Safety	
Medical Review	

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 366
Chlorobenzene

Issued: 11/82 Revision: B, 11/90

Section 1. Material Identification

33

Chlorobenzene (C_6H_5Cl) Description: Produced by chlorinating benzene in the presence of a catalyst. Used in dry cleaning; as a solvent in manufacturing paints, adhesives, polishes, waxes, diisocyanates, natural rubber, and pharmaceuticals; a chemical intermediate for phenol, *o*-, and *p*-chloronitrobenzene, DDT, and aniline; and an intermediate in manufacturing dyestuffs.

Other Designations: CAS No. 0108-90-7, benzene chloride; chlorobenzol; MCB; monochlorobenzene; phenyl chloride.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: Chlorobenzene is a skin and mucous membrane irritant, a fairly strong narcotic, and a central nervous system (CNS) depressant. Chronic inhalation may cause *lung, liver, and kidney damage.* This material is a dangerous fire hazard when exposed to heat or flame.

R 1
I 3
S 2
K 3

NFPA
3
2 0
-

HMIS
H 2
F 3
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Chlorobenzene, ca 100%

1989 OSHA PEL	1990-91 ACGIH TLV*	1988 NIOSH REL	1985-86 Toxicity Data†
8-hr TWA: 75 ppm, 350 mg/m³	TWA: 75 ppm, 345 mg/m³	None established	Rat, oral, LD_{50}: 2910 mg/kg; toxic effects not yet reviewed Rat, inhalation, TC_{Lo}: 210 ppm administered for 6 hr to a 6- to 15-day pregnant female produces specific developmental abnormalities
1987 IDLH Level 2400 ppm			

* In its "Notice of Intended Changes (for 1990-91)," the ACGIH lists a proposed lower level TWA for chlorobenzene: 10 ppm, 46 mg/m³.(159)
†See NIOSH, *RTECS* (CZ0175000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 270 °F (132 °C) at 760 mm Hg
Melting Point: -50.1 °F (-45.6 °C)
Vapor Pressure: 11.8 mm Hg at 77 °F (25 °C)
Vapor Density (Air = 1): 3.88
Viscosity: 0.790 centipoise at 70 °F (21 °C)
Molecular Weight: 112.56
Specific Gravity (20 °C/4 °C): 1.1058
Water Solubility: Insoluble

Appearance and Odor: A clear, colorless, volatile liquid with a faint, almond-like odor. Threshold odor concentration: 100% recognition, 0.21 ppm.

Section 4. Fire and Explosion Data

Flash Point: 85 °F (29.5 °C), CC	Autoignition Temperature: 1180 °F (638 °C)	LEL: 1.8% v/v	UEL: 9.6% v/v

Extinguishing Media: Use carbon dioxide, dry chemical, halon, water spray, or standard foam to extinguish fires involving chlorobenzene. Use water in flooding quantities as fog since solid streams of water may spread fire. Apply water spray from as far as possible to cool fire-exposed containers.

Unusual Fire or Explosion Hazards: Chlorobenzene is dangerous when exposed to heat or flame. Vapor may travel to an ignition source and flash back.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Do not extinguish fire unless flow can be stopped. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Chlorobenzene is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Chlorobenzene is incompatible with strong oxidizers; contact may cause fires and explosions. It reacts violently with dimethyl sulfoxide. Silver perchlorate forms a solvated, shock-sensitive salt with chlorobenzene (explosion). Chlorobenzene is potentially explosive with powdered sodium or phosphorus trichloride + sodium.

Conditions to Avoid: Avoid all heat and ignition sources and incompatible materials.

Hazardous Products of Decomposition: Thermal oxidative decomposition products of chlorobenzene can include soot, hydrogen chloride, phosgene, and carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, and OSHA do not list chlorobenzene as a carcinogen.
Summary of Risks: Chlorobenzene is a fairly strong narcotic and can cause central nervous system (CNS) depression. Overexposure is irritating to the eyes, nasal passages, and upper respiratory tract. It is moderately toxic by inhalation or ingestion and can be absorbed slowly through the skin. Short exposures to liquid may cause skin irritation and defatting, while prolonged or repeated skin contact may result in dermatitis or skin burns. Following absorption of toxic doses, liver and kidney degeneration are also observed. Chlorobenzene may also cause hemolysis.
Medical Conditions Aggravated by Long-Term Exposure: Individuals with skin, liver, kidney, or chronic respiratory disease may be at increased risk from exposure.
Target Organs: Respiratory system, eyes, skin, central nervous system, and liver.
Primary Entry Routes: Inhalation, ingestion, eye and skin contact.
Acute Effects: Symptoms to be expected from acute exposure are headache, eye and upper respiratory tract irritation, dizziness, drowsiness, cyanosis, spastic contractions of extremities, and loss of consciousness, depending on the exposure's concentration and duration. Symptoms of ingestion include pallor, cyanosis, and coma, followed by complete recovery.
Chronic Effects: Frequently repeated contact with chlorobenzene may result in skin burns, eye and upper respiratory tract irritation, headaches, dizziness, somnolence, and dyspeptic disorders (indigestion). Chronic inhalation may result in lung, liver, and kidney damage.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have that *conscious* person drink 1 to 2 glasses of water. Consult a physician immediately. If vomiting occurs, administer more water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: In a *conscious* patient, attempt to induce vomiting with Syrup of Ipecac. Consider activated charcoal cathartic. Administer charcoal slurry with saline, water, or sorbitol. In an *unconscious* patient, do gastric lavage with suction.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a chlorobenzene spill control and counter measure plan (SCCP).* Notify safety personnel, evacuate all unnecessary personnel, eliminate all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and contact with liquid. Take up spilled material with a noncombustible absorbent material and place into containers for disposal. For large spills, dike far ahead of spill to contain. Do not release runoff to sewers or waterways since chlorobenzene is harmful to aquatic life in very low concentrations. Aquatic toxicity: A 20-ppm concentration of chlorobenzene administered to bluegill in fresh water during a 96-hr test period is the median tolerance limit (TLm) at which 50% of the aquatic organisms survive. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

Listed as a RCRA Hazardous Waste (40 CFR 261.33), Hazardous Waste No. U037
CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 100 lb (45.4 kg) [* per Clean Water Act, Sec. 311(b)(4), Sec. 307(a), and per RCRA, Sec. 3001]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Use an organic vapor-acid gas respirator where appropriate. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets (polyvinyl alcohol is recommended) to prevent prolonged or repeated skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a well-ventilated, fire-resistant area away from heat and ignition sources and oxidizing agents. Outside or detached storage is preferred. Storage and handling must be suitable for an OSHA Class IC flammable liquid. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations in production and storage areas. Protect containers from physical damage.
Engineering Controls: Avoid vapor inhalation and contact with liquid. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures.
Other Precautions: Provide a preplacement questionnaire that emphasizes detecting a history of skin, liver, kidney, or chronic respiratory disease.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Chlorobenzene	**IMO Shipping Name:** Chlorobenzene
DOT Hazard Class: Flammable liquid	**IMO Hazard Class:** 3.3
ID No.: UN1134	**ID No.:** UN1134
DOT Label: Flammable liquid	**IMO Label:** Flammable liquid
DOT Packaging Exceptions: 173.118	**IMDG Packaging Group:** II
DOT Packaging Requirements: 173.119	

MSDS Collection References: 38, 73, 84, 85, 89, 100, 101, 103, 124, 126, 131, 132, 133, 136, 138, 139, 140, 143, 146, 148
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: AC Darlington, MD; Edited by: JR Stuart, MS

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 315
Chloroform

Issued: 11/77 Revision: D, 9/92

Section 1. Material Identification 39

Chloroform ($CHCl_3$) Description: Derived by chlorination of methane, hydrochlorination of methanol, or reaction of chlorinated lime with acetone, acetaldehyde, or ethanol. Purified by extraction with concentrated sulfuric acid and rectification. Used in the manufacture of fluorocarbons (mainly FC-22) for refrigerants, in plastics, photographic processing, fire extinguishers, insecticides, and dry cleaning; as a solvent for fats, oils, waxes, rubbers, alkaloids, Gutta-Percha, and resins. Used as an anesthetic since 1847 but abandoned within the last few decades because of cardiac arrest during surgery and delayed death due to liver injury.

Other Designations: CAS No. 67-66-3, Freon-20, methane trichloride, methenyl chloride, R-20 (refrigerant), trichloroform, trichloromethane, TCM. Improperly called 'formyl chloride.'

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: Chloroform is considered one of the most dangerous and volatile chlorinated hydrocarbons. It is a central nervous system (CNS) and cardiac depressant, an eye, skin, and respiratory tract irritant, and causes liver and kidney damage from acute and chronic exposure.

R 1
I 3
S 2*
K 2
* Skin absorption

NFPA
0
2 0
-

HMIS
H 3†
F 0
R 0
PPE‡
† Chronic effects
‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Chloroform, ca 99%. Usually contains 0.75% ethanol as a stabilizer. Impurities include bromodichloromethane, vinylidene, and diethyl carbonate.

1991 OSHA PEL
8-hr TWA: 2 ppm (9.78 mg/m^3)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
60 min STEL: 2 ppm (9.78 mg/m^3)

1992-93 ACGIH TLV
TWA: 10 ppm (49 mg/m^3)

1990 DFG (Germany) MAK
TWA: 10 ppm (50 mg/m^3)
Category II: Substances with systemic effects. Half-life = 2 hr
Peak Exposure Limit: 20 ppm, 30 min average value, 4/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 10 mg/m^3/1 year caused anorexia, nausea, and vomiting.
Rat, oral, TD_{Lo}: 13832 mg/kg given continuously for 2 years caused leukemia.
Rat, oral, LD_{50}: 908 mg/kg caused weight loss or decreased weight gain.
Rat, inhalation, TC_{Lo}: 30 ppm/7 hr administered from the 6 to 15 day of pregnancy caused fetotoxicity or developmental abnormalities of the musculoskeletal system.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.

* See NIOSH, *RTECS* (FS9100000), for additional irritation, mutation, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 143 °F (62 °C)
Freezing Point: -82 °F (-63.5 °C)
Molecular Weight: 119.39
Viscosity: 5.63 mP at 68 °F (20 °C)
Relative Evaporation Rate (BuAc=1): 11.6
Surface Tension: 27.1 dyne/cm at 68 °F (20 °C)
Refraction Index: 1.4422 at 77 °F (25 °C)

Density: 1.49845 at 59 °F (15 °C)
Water Solubility: Nearly insoluble; 0.5% at 77 °F (25 °C)
Other Solubilities: Soluble in ethanol, ethyl ether, benzene, acetone, carbon disulfide, and carbon tetrachloride.
Odor Threshold: 85 to 307 ppm (*range from combined sources*)
Vapor Pressure: 160 mm Hg at 68 °F (20 °C); 200 mm Hg at 77 °F (25 °C)
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.136 lb/ft^3 or 2.183 kg/m^3

Appearance and Odor: Colorless, volatile liquid with a heavy, ethereal odor.

Section 4. Fire and Explosion Data

Flash Point: Nonflammable	**Autoignition Temperature:** Nonflammble	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Nonflammable from standard tests in air but will burn on prolonged exposure to flame or high temperature. To fight fire, use extinguishing agents suitable for surrounding fire. *Do not* scatter material with a high-pressure water stream. **Unusual Fire or Explosion Hazards:** Container may explode in heat of fire. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is *not* effective. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Chloroform is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. It's pH decreases on prolonged exposure to air and light due to hydrochloric acid (HCl) formation. The recommended shelf-life is 2 months for full containers and 2 weeks for partially full containers. **Chemical Incompatibilities:** Incompatible with acetone, alkalis, aluminum, disilane, lithium, magnesium, dinitrogen dioxide, nitrogen tetroxide, perchloric acid, phosphorus pentoxide, potassium, potassium hydroxide, methyl alcohol, potassium *tert*-butoxide, sodium, sodium hydroxide, sodium methylate, sodium-potassium alloy, triisopropylphosphine, calcium hydroxide, and fluorine and any strong oxidizers. **Conditions to Avoid:** Exposure to light, prolonged heat, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of $CHCl_3$ can produce carbon dioxide and toxic chlorine, HCl, and phosgene gas. $CHCl_3$ decomposes at 437 °F to formic acid, carbon monoxide, and HCl on prolonged heating with water.

Section 6. Health Hazard Data

Carcinogenicity: Chloroform is considered a carcinogen by the IARC (Class-2B, possibly carcinogenic in humans with limited human and sufficient animal evidence),(164) NTP (Class 2, reasonably anticipated to be a carcinogen, limited human and sufficient animal evidence),(169) and NIOSH (Class X, carcinogen defined with no further categorization),(164) DFG (MAK-B, justifiably suspected of having carcinogenic potential),(163) and ACGIH (Class A2, suspected human carcinogen based on limited epidemiologic evidence or demonstration)(163). Carcinogenicity tends to be organ specific primarily to the liver and kidneys. **Summary of Risks:** Chloroform is a CNS depressant, eye, skin, and respiratory tract irritant, and causes damage to the liver and kidneys. Symptoms range from dizziness to cardiac arrythmias resulting in death. Chloroforms' toxicity is due to its easy lipid solubility. Avoid exposure during pregnancy because $CHCl_3$ diffuses readily across the placenta. Alcoholics seem to be affected sooner and more severely than others from chloroform exposure (alcohol may already have damaged the liver). Ethanol, polybrominated biphenols, steroids, and ketones potentiate chloroform's toxicity.

Continue on next page

Section 6. Health Hazard Data

Target Organs: Liver, kidney, heart, eyes, skin. **Primary Entry Routes:** Inhalation, ingestion, skin contact/absorption. **Medical Conditions Aggravated by Long-Term Exposure:** Alcoholism, liver, kidney, or nervous system disorders. **Acute Effects:** Vapor inhalation causes varying degrees of CNS depression depending on concentration and exposure length. Symptoms include headache, nausea, dizziness, drunkenness, progressive weakness, vomiting, thirst, delirium, and disorientation. Exposure to 14,000 to 16,000 ppm has caused rapid unconsciousness. Severe acute exposures can damage the liver and kidney (damage is usually not observed for 24 to 48 hr post exposure), respiratory failure, severe cardiac arrythmias (reason for discontinuation of use as an anesthetic), and death. Apparent recovery from heavy exposures may result in delayed death due to liver or kidney failure. Death usually occurs 4 to 5 days post exposure and autopsy shows massive liver necrosis. Vapors cause eye irritation and spasmodic winking. Direct eye contact with the liquid causes immediate burning pain and possible corneal epithelium damage. Skin contact with the liquid produces burning pain, erythema, and vesiculation due to defatting of the skin. Ingestion can cause gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, unconsciousness, and state of shock. **Chronic Effects:** Prolonged inhalation of chloroform vapors causes fatigue, digestive disturbances, frequent and burning urination, mental dullness, and CNS and peripheral neuropathies. Liver (fatty degeneration and enlargement with hepatitis seen in dogs) and kidney damage may also occur.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, to dilute. *Do not* induce vomiting because victim may become obtunded. Gastric lavage may be indicated if patient is comatose or at risk of convulsing. **Note to Physicians:** Because effects may be delayed (especially kidney and liver problems), keep victim under observation for 24 to 48 hr. Administration of fluids may help to prevent kidney failure. Obtain blood glucose, urinalysis, liver function tests, chest x-ray, and monitor cardiac function and fluid/electrolyte status. Monitor liver and kidney function for 4 to 5 days after exposure. Disulfiram, its metabolites, and a high carbohydrate diet appear to protect somewhat against chloroform toxicity. *Do not give adrenalin!* Tests may show increased bilirubin, ketosis, lowered blood prothrombin, and fibrogen.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. If possible without risk, move container from spill area. Cleanup personnel should wear fully encapsulating vapor-protective clothing. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for disposal. For large spills, dike far ahead of spill and contain for later disposal or reclamation. Spills in water may need to be trapped at the bottom with sand bag barriers and treated with activated carbon and removed by suction hoses, mechanical lifts, and dredges. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Rainbow Trout (*Salmo gairdneri*), LC_{50} = 2030 µg/L; bluegill (*Lepomis macrochirus*), LC_{50} = 100,000 µg/L/96 hr; largemouth bass (*Micropterus salmoides*) LC_{50} = 51 ppm/96 hr. **Environmental Degradation:** If released to land, most chloroform evaporates rapidly (due to high vapor pressure) while some may leach to groundwater where it remains for a long time on the bottom. If released to water, chloroform evaporates rapidly with estimated half-lifes of 36 hr (river), 40 hr (pond), 9 to 10 days (lake). In air, chloroform photodegrades with a half-life of 80 days. It can be transported long distances and some may return to earth via rain. **Disposal:** Reclamation is possible through distillation or steam stripping. Chloroform is a candidate for liquid injection, rotary kiln, or fluidized bed incineration with an acid scrubber. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U044
Listed as a SARA Extremely Hazardous Substance (40 CFR 355), TPQ: 10,000 lb
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 10 lb (4.54 kg) [* per RCRA, Sec. 3001; CWA, Sec. 311(b)(4), & CWA Sec. 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles for concentrations of 5 ppm to 2% and a full facepiece for levels above 2%, per OSHA eye- and face-
rotection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek
rofessional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/
IOSH-approved respirator. For any detectable concentration use a supplied-air respirator or SCBA with a full facepiece and operated in pressure-
emand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
arning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written
spiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance,
spection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of
olyvinyl alcohol or Viton (breakthrough times > 1 hr) to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to
aintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion
to the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-
ench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before
use. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas.
actice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

ection 9. Special Precautions and Comments

orage Requirements: Prevent physical damage to containers. Store in lead-lined or mild steel containers of all-welded construction in a cool (<30
), dry, well-ventilated area away from direct light and incompatibles. **Engineering Controls:** To reduce potential health hazards, use sufficient
lution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Isolate operations
volving chloroform. **Administrative Controls:** It is suggested that chloroform use for extractions in labs should be avoided and replaced because
its toxicity and carcinogenic potential. Consider preplacement and periodic medical exams of exposed workers.

Transportation Data (49 CFR 172.101)

T Shipping Name: Chloroform
T Hazard Class: 6.1
No.: UN1888
T Packing Group: II
T Label: Poison
ecial Provisions (172.102): N36, T14

Packaging Authorizations
a) Exceptions: None
b) Nonbulk Packaging: 173.202
c) Bulk Packaging: 173.243

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

DS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 153, 159, 163, 164, 167, 168, 169, 171, 174, 175, 176, 180.
pared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 702
Chloropicrin

Issued: 4/90

Section 1. Material Identification

31

Chloropicrin Description: Manufactured from nitromethane and alkaline hypochlorite. Previously used as a war gas. Used as a soil insecticide, a fumigant, and a fungicide; in disinfecting cereals and grains; to kill weed and grass seeds in soil; and in manufacturing methyl violet.
Other Designations: CAS No. 0076-06-2; CCl_3NO_2; acquinite; nitrochloroform; nitrotrichloromethane; picfume; trichloronitromethane.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R 1
I 4
S 3
K 0

NFPA

HMIS
H 4
F 0
R 3
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Chloropicrin, ca 100%

OSHA PEL	**ACGIH TLVs, 1989-90**	**NIOSH REL, 1987**	**Toxicity Data***
8-hr TWA: 0.1 ppm, 0.7 mg/m^3	TLV-TWA: 0.1 ppm, 0.67 mg/m^3 TLV-STEL: 0.3 ppm, 2.0 mg/m^3	None established	Rat, oral, LD_{50}: 250 mg/kg Rabbit, inhalation, TC_{Lo}: 800 mg/m^3 for 20 min Human, inhalation, TC_{Lo}: 2 mg/m^3

* See NIOSH, *RTECS* (PB6300000), for additional mutative, tumorigenic, and toxicity data.

Section 3. Physical Data

Boiling Point: 234 °F/112 °C
Melting Point: -92.6 °F/-69.2 °C
Vapor Pressure: 5.7 mm Hg at 32 °F/0 °C
Vapor Density (Air = 1): 5.7
Molecular Weight: 164.39 g/mol
Specific Gravity (H_2O = 1 at 39 °F/4 °C): 1.6558 at 68 °F/20 °C
Water Solubility: Insoluble

Appearance and Odor: A colorless, slightly oily liquid with a very intense, penetrating odor. The threshold odor concentration is 1.1 ppm.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Since chloropicrin is a noncombustible liquid, use extinguishing media appropriate to the surrounding fire.
Unusual Fire or Explosion Hazards: Chloropicrin detonates if heated under confinement.
Special Fire-fighting Procedures: Since this material is extremely toxic, enter contaminated areas only with a self-contained breathing apparatus (SCBA) and shipper- or producer-recommended chemical protective clothing. Fight fires with hoseholders or unmanned monitors from an explosion-resistant location. Keep fire-exposed containers cool. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Chloropicrin is relatively stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. There are reports of photochemical transformation of chloropicrin into toxic phosgene (carboxy chloride, $COCl_2$).
Chemical Incompatibilities: This material is incompatible with strong oxidizers. A violent reaction occurs with alcoholic sodium hydroxide, propargyl bromide, sodium methoxide, and aniline + heat.
Conditions to Avoid: Above a critical volume chloropicrin can be shocked into detonation. Mixtures with 3-bromopropyne are also shock- and heat-sensitive explosives.
Hazardous Products of Decomposition: Thermal oxidative decomposition of chloropicrin can produce very toxic fumes of chlorine (Cl-) and nitrogen oxides (NO_x). This material forms a powerful tear gas when heated.

Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists chloropicrin as a carcinogen.
Summary of Risks: Chloropicrin is a severe eye, mucous membrane, lung, and skin irritant. Its IDLH (*i*mmediately *d*angerous to *l*ife and *h*ealth) level is 4 ppm; 119 ppm for 30 min is lethal for humans. Concentrations of 15 ppm are tolerable no longer than 1 min, 4 ppm are temporarily disabling due to their irritant effect, and 0.3 to 0.37 ppm causes painful irritation in 3 to 30 sec. Congestion, edema, hemorrhage, and infiltration of the lung tissue, particularly the medium and small bronchi, are the major pathological manifestations in the early stages. A 1-ppm concentration is a good warning of exposure since it causes a smarting pain in the eyes. When used as a war gas, chloropicrin's intense gastrointestinal effects earned it the name "vomiting gas." Another toxic effect is its interference with oxygen transport by reaction with SH-groups in hemoglobin.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Respiratory system, skin, eyes.
Primary Entry Routes: Inhalation.
Acute Effects: Vapor inhalation causes severe irritation of the eyes and nose, lacrimation, bronchitis and pulmonary edema, skin irritation, and nausea, vomiting, colic, diarrhea, and gastrointestinal irritation.
Chronic Effects: Necroses of the kidneys, liver, and skeletal muscles are noted in rats in the chronic stage of chloropicrin exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 4 to 8 oz of water or milk to dilute.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: Keep victim under close observation for 72 hr since the effects may be delayed. Surveillance after significant acute exposure should include monitoring of respiratory rate, serial chest X-rays, and arterial gas levels. Maintain supportive care. Consider using steroids for significant pulmonary inflammation.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a chloropicrin spill control and countermeasure plan* (SCCP). Notify safety personnel, evacuate all unnecessary personnel, and provide adequate ventilation. Cleanup personnel must wear SCBA and chemical protective clothing to avoid vapor inhalation and contact with all body surfaces. Cover spilled material with soda ash, mix, and spray with water. Place this material in a container, let it stand in a well-ventilated area for two hours, and neutralize with 6M-HCl. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134). For concentrations up to the 4-ppm IDLH level, use a gas mask with an organic vapor canister. For concentrations exceeding the IDLH, wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious, neoprene gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL and ACGIH TLV (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials (Sec. 5). Outside or detached storage is preferred. Protect containers from physical damage or shock. Do not use magnesium, aluminum, or their alloys for handling equipment or containers. One-pound glass bottles in hermetically sealed metal cans are recommended.
Engineering Controls: Since chloropicrin is an extremely toxic material, take precautionary measures before handling. Short exposures may cause fatal lung diseases. Institute a respiratory protection program which includes training, maintenance, inspection, and evaluation. Use chloropicrin only with appropriate personal protective gear. Provide preplacement and annual medical examinations which emphasize the respiratory system and skin.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Chloropicrin, liquid
DOT Hazard Class: Poison B
ID No.: UN1580
DOT Label: Poison
DOT Packaging Requirements: 173.357
DOT Packaging Exceptions: None

IMO Shipping Name: Chloropicrin
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: I
ID No.: UN1580

MSDS Collection References: 38, 73, 84, 85, 87, 88, 89, 90, 100, 103, 109, 123, 124, 126, 132, 134, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 470
Diesel Fuel Oil No. 2-D

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

33

Diesel Fuel Oil No. 2-D Description: Diesel fuel is obtained from the middle distillate in petroleum separation; a distillate oil of low sulfur content. It is composed chiefly of unbranched paraffins. Diesel fuel is available in various grades, one of which is synonymous with fuel oil No. 2-D. This diesel fuel oil requires a minimum Cetane No. (efficiency rating for diesel fuel comparable to octane number ratings for gasoline) of 40 (ASTM D613). Used as a fuel for trucks, ships, and other automotive engines; as mosquito control (coating on breeding waters); and for drilling muds.

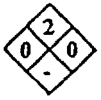
Other Designations: CAS No. 68334-30-5, diesel fuel.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

Cautions: Diesel fuel oil No. 2-D is a skin irritant and central nervous depressant with high mist concentrations. It is an environmental hazard and moderate fire risk.

R 1
I -
S 2
K 2

NFPA



HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Diesel fuel oil No. 2-D*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data‡
None established	Mineral Oil Mist TWA: 5 mg/m³† STEL: 10 mg/m³	None established	Rat, oral, LD_{50}: 9 g/kg produces gastrointestinal (hypermotility, diarrhea) effects

* Diesel fuel No. 2-D tends to be low in aromatics and high in paraffinics. This fuel oil is complex mixture of: 1) >95% paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, 2) sulfur (<0.5%), and 3) benzene (<100 ppm). [A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)]. Although low in the fuel itself, benzene concentrations are likely to be much higher in processing areas.

† As sampled by nonvapor-collecting method.

‡ Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point Range: 340 to 675 °F (171 to 358 °C)

Viscosity: 1.9 to 4.1 centistoke at 104 °F (40 °C)

Specific Gravity: <0.86

Water Solubility: Insoluble

Appearance and Odor: Brown, slightly viscous liquid.

Section 4. Fire and Explosion Data

Flash Point: 125 °F (52 °C) min.	**Autoignition Temperature:** >500 °F (932 °C)	**LEL:** 0.6% v/v	**UEL:** 7.5% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or foam to fight fire. Use a water spray to cool fire exposed containers. Do not use a forced water spray directly on burning oil since this will scatter the fire. Use a smothering technique for extinguishing fire.

Unusual Fire or Explosion Hazards: Diesel fuel oil No. 2-D is a OSHA Class II combustible liquid. Its volatility is similar to that of gas oil. Vapors may travel to a source of ignition and flash back.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to pollution and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Diesel fuel oil No. 2-D is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: It is incompatible with strong oxidizing agents; heating greatly increases the fire hazard.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of diesel fuel oil No. 2-D can produce various hydrocarbons and hydrocarbon derivatives, and other partial oxidation products such as carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: Although the IARC has not assigned an overall evaluation to diesel fuels as a group, it has evaluated occupational exposures in petroleum refining as an IARC probable human carcinogen (Group 2A). It has evaluated distillate (light) diesel oils as not classifiable as human carcinogens (Group 3).

Summary of Risks: Although diesel fuel's toxicologic effects should resemble kerosine's, they are somewhat more pronounced due to additives such as sulfurized esters. Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, vomiting, and loss of coordination, depending on concentration and exposure time. When removed from exposure area, affected persons usually recover completely. If vomiting occurs after ingestion and if oil is aspirated into the lungs, hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result. A comparative ratio of oral to aspirated lethal doses may be 1 pt vs. 5 ml. Aspiration may also result in transient CNS depression or excitement. Secondary effects may include hypoxia (insufficient oxygen in body cells), infection, pneumatocele formation, and chronic lung dysfunction. Inhalation may result in euphoria, cardiac dysrhythmias, respiratory arrest, and CNS toxicity. Prolonged or repeated skin contact may irritate hair follicles and block sebaceous glands, producing a rash of acne pimples and spots, usually on arms and legs.

Medical Conditions Aggravated by Long-Term Exposure: None reported.

Target Organs: Central nervous system, skin, and mucous membranes.

Primary Entry Routes: Inhalation, ingestion.

Acute Effects: Systemic effects from ingestion include gastrointestinal irritation, vomiting, diarrhea, and in severe cases central nervous system depression, progressing to coma or death. Inhalation of aerosols or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish discoloration of the skin and mucous membranes caused by deficient blood oxygenation).

Chronic Effects: Repeated contact with the skin causes dermatitis.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.

Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body have been exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately. Position to avoid aspiration.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Diesel fuel oil No. 2-D spills may be environmental hazards. Report large spills.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste

CERCLA Hazardous Substance (40 CFR 302.4): Not listed

SARA Extremely Hazardous Substance (40 CFR 355): Not listed

SARA Toxic Chemical (40 CFR 372.65): Not listed

OSHA Designations

Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with a mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*

Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.

Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)

Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.

Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.

Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for a OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in storage or use areas.

Engineering Controls: Avoid vapor or mist inhalation and prolonged skin contact. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist concentration may occur. Additional suitable protective clothing may be required depending on working conditions. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. At least weekly laundering of work clothes is recommended. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Fuel oil

DOT Hazard Class: Combustible liquid

ID No.: NA1993

DOT Label: None

DOT Packaging Exceptions: 173.118a

DOT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 101, 103, 126, 127, 132, 133, 136, 143, 146
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** AC Darlington, MD; **Edited by:** JR Stuart, MS

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 468
Fuel Oil No. 1

Issued: 3/82 Revision: A, 11/90

Section 1. Material Identification

33

Fuel Oil No. 1 Description: A kerosine-like mixture of petroleum hydrocarbons; a distillate of controlled sulfur content. Fuel oil no. 1 is available for home heating use.

Other Designations: Coal oil, heating fuel, kerosene, kerosine, range oil.

Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[(73)] for a suppliers list.

R 1
I -
S 1
K 2

NFPA
2
0 0
-

HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Cautions: Fuel oil No. 1 is a skin, eye, and mucous membrane irritant and central nervous system (CNS) depressant. Ingestion may lead to *aspiration pneumonitis*. It is *flammable* when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 1, ca 100%

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data*
None established	None established	None established	Rat, oral, LD_{50}: 9 g/kg; produces gastrointestinal effects (hypermotility, diarrhea)

* Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Range: 302 to 554 °F (150 to 290 °C)
Freezing Point: -40 °F (-40 °C)
Vapor Pressure, 100 °F (38 °C): ca 5
Viscosity: 160 centistoke at 99.5 °F (37.5 °C)
Specific Gravity: 0.8251 at 59 °F (15 °C)
Water Solubility: Insoluble
% Volatile by Volume: >99

Appearance and Odor: Light amber liquid with a mild petroleum odor.

Section 4. Fire and Explosion Data

Flash Point: 100 to 162 °F (43 to 72 °C)	Autoignition Temperature: 410 °F (210 °C)	LEL: 0.7% v/v	UEL: 5% v/v

Extinguishing Media: Use dry chemcial, carbon dioxide, foam, water fog or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire.

Unusual Fire or Explosion Hazards: *Caution!* Vapors may spread to an ignition or heat source and burn with explosive violence.

Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. Be aware of runoff from fire control methods. Do not release to sewers or waterways due to health and fire or explosion hazard.

Section 5. Reactivity Data

Stability/Polymerization: Fuel oil no. 1 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Fuel oil no. 1 is incompatible with strong oxidizing agents; heating greatly increases fire hazard.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of fuel oil no. 1 can produce carbon dioxide; incomplete combustion can produce carbon monoxide.

Section 6. Health Hazard Data

Carcinogenicity: Although the IARC has not assigned an overall evaluation, it has evaluated occupational exposures in petroleum refining as IARC probable human carcinogens (Group 2A).

Summary of Risks: Fuel oil No. 1 is insufficiently volatile to constitute an acute inhalation hazard. Excessive inhalation of *aerosol* or *mist* can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and exposure time. When removed from exposure area, affected persons usually experience complete recovery. Death may occur by asphyxiation due to

Continue on next page

Section 6. Health Hazard Data, *continued*

pulmonary edema and consolidation. Late lung changes are noted in survivors. The characteristic lung lesion is an acute, fulminant, hemorrhagic bronchopneumonia. Other systemic effects include heart (potentially fatal rhythm disturbances), liver, kidney, bone marrow and spleen changes. The mean oral lethal dose is ~4 to 6 oz, with death occurring within 2 to 24 hr. Hemorrhaging and pulmonary edema, progressing to renal involvement and chemical pneumonitis, may result if vomiting occurs after ingestion, and oil is aspirated into the lungs. Death may result from as little as 1/2 oz, while survival is noted up to 12 oz ingested. Ingestion's systemic effect is primarily central nervous system (CNS) depression which may lead to coma and respiratory depression. Gastrointestinal (GI) lining irritation may cause burning of mouth, esophagus, and stomach, as well as vomiting, intestinal cramping, and blood-tinged diarrhea. Fuel oil No. 1 is irritating to skin and mucous membranes. Percutaneous absorption may be significant. Prolonged contact may cause significant skin damage (epidermal necrolysis, or scalded skin appearance). Kidney damage appears to occur at higher frequency after prolonged skin exposure. Eye contact with liquid or vapor may cause irritation.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system, skin, and mucous membranes.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic effects from ingestion include GI irritation, vomiting, diarrhea, and, in severe cases, CNS depression, progressing to coma and death. Inhalation of aerosol or mists may result in increased respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish coloration of skin and mucous membranes caused by deficient blood oxygenation).
Chronic Effects: Repeated skin contact causes dermatitis.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. If large areas of the body are exposed or if irritation persists, get medical help immediately. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Contact a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk. In cases of severe aspiration pneumonitis, consider monitoring arterial blood gases to ensure adequate ventilation. Observe the patient for 6 hr. If vital signs become abnormal or symptoms develop, obtain a chest x-ray.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclamation or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.21): Ignitable waste
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Nitrile or polyvinyl alcohol gloves are recommended.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for an OSHA Class II combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in areas of storage or use.
Engineering Controls: Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area and with personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil contaminated clothing. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)
DOT Shipping Name: Fuel oil
DOT Hazard Class: Combustible liquid
ID No.: NA1993
DOT Label: None
DOT Packaging Exceptions: 173.118a
DOT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 103, 126, 131, 132, 133, 136, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 474
Fuel Oil No. 6

Issued: 10/81 Revision: A, 11/90

Section 1. Material Identification

Fuel Oil No. 6 Description: A high-viscosity residual oil. Used to power heavy units such as ships, trucks, and trains. A thick paste, fuel oil No. 6 is not usually used unless preheated to decrease its viscosity.
Other Designations: CAS No. 68553-00-4, bunker C.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*[73] for a suppliers list.

R	1
I	-
S	2
K	2

NFPA

HMIS
H 0
F 2
R 0
PPG*
* Sec. 8

Cautions: Fuel oil No. 6 is a respiratory irritant and central nervous system (CNS) depressant. It is a moderate fire hazard when exposed to heat or flame.

Section 2. Ingredients and Occupational Exposure Limits

Fuel oil No. 6*

1989 OSHA PEL	1990-91 ACGIH TLV	1988 NIOSH REL	1985-86 Toxicity Data†
None established	None established	None established	Rat, oral, LD_{50}: 9 g/kg

* A complex mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, including polycyclic aromatic hydrocarbons. Sulfur content is <2.8%. A fuel oil No. 6 with low sulfur (0.2 and 1.2%) is commercially available.
† Monitor NIOSH, *RTECS* (HZ1800000), for future toxicity data.

Section 3. Physical Data

Boiling Point: 500 °F (>260 °C)
Vapor Pressure: 0.2 mm Hg at 70 °F (21 °C)
Viscosity: 36,000 centistoke at 100 °F (37.8 °C)
Specific Gravity: ~0.966
Water Solubility: Insoluble
Appearance and Odor: Black liquid to heavy paste with a petroleum odor.

Section 4. Fire and Explosion Data

Flash Point: 150 to 270 °F (66 to 132 °C)	Autoignition Temperature: 765 °F (407 °C)	LEL: 3.9% v/v	UEL: 20.1% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, foam, water fog, or spray. Do not use a forced water spray directly on burning oil since this scatters the fire. Use a smothering technique to extinguish fire. Cool fire-exposed containers with water spray.
Unusual Fire or Explosion Hazards: Fuel oil No. 6 is an OSHA Class IIIA combustible liquid that exhibits "boil-over" characteristics.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode and full protective clothing. If feasible, remove containers from fire hazard area. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Fuel oil No. 6 is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Conditions to Avoid: Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition of fuel oil No. 6 can produce various hydrocarbons and hydrocarbon derivatives and partial oxidation products including carbon dioxide, carbon monoxide, and sulfur dioxide.

Section 6. Health Hazard Data

Carcinogenicity: The IARC lists fuel oils, residual (heavy) as possible human carcinogen (Group 2B); animal evidence-limited.
Summary of Risks: Residual oils are generally more viscous and less toxic than kerosene due to their low volatility and limited absorption through the intestinal tract. Inhalation of heated or misted fuel oil No. 6 can cause the same systemic and local pulmonary effects seen with lighter grade fuel oils, respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and time of exposure. When removed from exposure area, affected persons usually experience complete recovery. The residual (heavy) oils have a lower aspiration hazard since heavy oils are more viscous. Aspiration is limited to inhalation from vomiting after ingestion and dilution with gastric contents. Significant ingestion is unlikely. In addition, intestinal absorption of long-chain hydrocarbons is low. Its primary toxicities, then, are its laxative effect, mild gastrointestinal (GI) irritation, and skin irritation. After prolonged skin contact, changes in rabbit bladder linings are reported. Prolonged or repeated skin contact may cause irritation and block the sebaceous glands, with a rash of acne-like pimples and spots, usually on the arms and legs. Repeated prolonged dermal contact may also have systemic effects. Heavy repeated application of fuel oil No. 6 to rabbit skin gave severe skin changes and systemic toxicity including an increased incidence of hyperplasia of the urinary bladder epithelium.*
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Central nervous system (CNS), skin, and mucous membranes.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: Systemic effects from ingestion include gastrointestinal (GI) irritation, vomiting, diarrhea, and in severe cases, CNS depression, progressing to coma and death. Inhalation of aerosol or mists may result in increased rate of respiration, tachycardia (excessively rapid heart beat), and cyanosis (dark purplish coloration of the skin and mucous membranes caused by deficient oxygentation of the blood).
Chronic Effects: Repeated skin contact causes dermatitis and possible systemic toxicity.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting*. Consulting a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Gastric lavage is contraindicated due to aspiration hazard. Preferred antidotes are charcoal and milk.

---

* EPA (TOSCA) document 8EHQ-0181-0377, December, 1980.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate area for large spills, remove all heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Clean up spills promptly to reduce fire or vapor hazards. Use a noncombustible absorbent material to pick up small spills or residues. For large spills, dike far ahead to contain. Pick up liquid for reclaim or disposal. Do not release to sewers or waterways due to health and fire and/or explosion hazard. Follow applicable OSHA regulations (29 CFR 1910.120). Report large oil spills.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use a NIOSH-approved respirator with mist filter and organic vapor cartridge. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations that promote worker safety and productivity. Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.(103)
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Use and storage conditions should be suitable for an OSHA Class IIIA combustible liquid. Store in closed containers in a well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Use nonsparking tools and explosion-proof electrical equipment. No smoking in area of storage or use.
Engineering Controls: Avoid prolonged skin contact and vapor or mist inhalation. Use only in a well-ventilated area with personal protective gear. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Practice good personal hygiene and housekeeping procedures. Do not wear oil-contaminated clothing. Do not put oily rags in pockets. When working with this material, wear gloves or use barrier cream.

Transportation Data (49 CFR 172.101)
DOT Shipping Name: Fuel oil
DOT Hazard Class: Combustible liquid
ID No.: NA1993
DOT Label: None
DOT Packaging Exceptions: 173.118a
DOT Packaging Requirements: None

MSDS Collection References: 1, 6, 7, 12, 73, 84, 103, 126, 131, 132, 133, 136, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 467
Automotive Gasoline, Lead-free

Issued: 10/81 Revision: A, 9/91

Section 1. Material Identification

35

Automotive Gasoline, Lead-free, Description: A mixture of volatile hydrocarbons composed mainly of branched-chain paraffins, cycloparaffins, olefins, naphthenes, and aromatics. In general, gasoline is produced from petroleum, shale oil, Athabasca tar sands, and coal. Motor gasolines are made chiefly by cracking processes, which convert heavier petroleum fractions into more volatile fractions by thermal or catalytic decomposition. Widely used as fuel in internal combustion engines of the spark-ignited, reciprocating type. Automotive gasoline has an octane number of approximately 90. A high content of aromatic hydrocarbons and a consequent high toxicity are also associated with a high octane rating. Some gasolines sold in the US contain a minor proportion of tetraethyllead, which is added in concentrations not exceeding 3 ml per gallon to prevent engine "knock." However, methyl-tert-butyl ether (MTBE) has almost completely replaced tetraethyllead.

Other Designations: CAS No. 8006-61-9, benzin, gasoline, gasolene, motor spirits, natural gasoline, petrol.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[(73)] for a suppliers list.

R	1
I	2
S	2*
K	4

* Skin absorption

NFPA

HMIS

H	2
F	3
R	1
PPG†	

† Sec. 8

Cautions: Inhalation of automotive gasoline vapors can cause intense burning in throat and lungs, central nervous system (CNS) depression, and possible fatal pulmonary edema. Gasoline is a dangerous fire and explosion hazard when exposed to heat and flames.

Section 2. Ingredients and Occupational Exposure Limits

Automotive gasoline, lead-free*

1990 OSHA PELs
8-hr TWA: 300 ppm, 900 mg/m^3
15-min STEL: 500 ppm, 1500 mg/m^3

1990-91 ACGIH TLVs
TWA: 300 ppm, 890 mg/m^3
STEL: 500 ppm, 1480 mg/m^3

1990 NIOSH REL
None established

1985-86 Toxicity Data*
Man, inhalation, TC_{Lo}: 900 ppm/1 hr; toxic effects include sense organs and special senses (conjunctiva irritation), behavioral (hallucinations, distorted perceptions), lungs, thorax, or respiration (cough)
Human, eye: 140 ppm/8 hr; toxic effects include mild irritation
Rat, inhalation, LC_{50}: 300 g/m^3/5 min

* A typical modern gasoline composition is 80% paraffins, 14% aromatics, and 6% olefins. The mean benzene content is approximately 1%. Other additives include sulfur, phosphorus, and MTBE.

† See NIOSH, *RTECS* (LX3300000), for additional toxicity data.

Section 3. Physical Data

Boiling Point: Initially, 102 °F (39 °C); after 10% distilled, 140 °F (60 °C); after 50% distilled, 230 °F (110 °C); after 90% distilled, 338 °F (170 °C); final boiling point, 399 °F (204 °C)
Vapor Density (air = 1): 3.0 to 4.0
Density/Specific Gravity: 0.72 to 0.76 at 60 °F (15.6 °C)
Water Solubility: Insoluble

Appearance and Odor: A clear (gasoline may be colored with dye), mobile liquid with a characteristic odor recognizable at about 10 ppm in air.

Section 4. Fire and Explosion Data

Flash Point: -45 °F (-43 °C)	**Autoignition Temperature:** 536 to 853 °F (280 to 456 °C)	**LEL:** 1.3% v/v	**UEL:** 6.0% v/v

Extinguishing Media: Use dry chemical, carbon dioxide, or alcohol foam as extinguishing media. Use of water may be ineffective to extinguish fire, but use water spray to knock down vapors and to cool fire-exposed drums and tanks to prevent pressure rupture. Do not use a solid stream of water since it may spread the fuel.

Unusual Fire or Explosion Hazards: Automobile gasoline is an OSHA Class IB flammable liquid and a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow to an ignition source and flash back. Automobile gasoline can also react violently with oxidizing agents.

Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode, and full protective clothing. When the fire is extinguished, use nonsparking tools for cleanup. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Automotive gasoline is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Automotive gasoline can react with oxidizing materials such as peroxides, nitric acid, and perchlorates.

Conditions to Avoid: Avoid heat and ignition sources.

Hazardous Products of Decomposition: Thermal oxidative decomposition of automotive gasoline can produce oxides of carbon and partially oxidized hydrocarbons.

Section 6. Health Hazard Data

Carcinogenicity: In 1990 reports, the IARC list gasoline as a possible human carcinogen (Group 2B). Although the IARC has assigned an overall evaluation to gasoline, it has not assigned an overall evaluation to specific substances within this group (inadequate human evidence).
Summary of Risks: Gasoline vapors are considered moderately poisonous. Vapor inhalation can cause central nervous system (CNS) depression and mucous membrane and respiratory tract irritation. Brief inhalations of high concentrations can cause a fatal pulmonary edema. Reported responses to gasoline vapor concentrations are: 160 to 270 ppm causes eye and throat irritation in several hours; 500 to 900 ppm causes eye, nose, and throat irritation, and dizziness in 1 hr; and 2000 ppm produces mild anesthesia in 30 min. Higher concentrations are intoxicating in 4 to 10 minutes. If large areas of skin are exposed to gasoline, toxic amounts may be absorbed. Repeated or prolonged skin exposure causes dermatitis. Certain individuals may develop hypersensitivity. Ingestion can cause CNS depression. Pulmonary aspiration after ingestion can cause severe pneumonitis. In adults, ingestion of 20 to 50 g gasoline may produce severe symptoms of poisoning.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Target Organs: Skin, eye, respiratory and central nervous systems.
Primary Entry Routes: Inhalation, ingestion, skin contact.
Acute Effects: Acute inhalation produces intense nose, throat, and lung irritation; headaches; blurred vision; conjunctivitis; flushing of the face; mental confusion; staggering gait; slurred speech; and unconsciousness, sometimes with convulsions. Ingestion causes inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (a blue to dark purplish coloration of skin and mucous membrane caused by lack of oxygen). Aspiration causes choking, cough, shortness of breath, increased rate of respiration, excessively rapid heartbeat, fever, bronchitis, and pneumonitis. Other symptoms following acute exposure include acute hemorrhage of the pancreas, fatty degeneration of the liver and kidneys, and passive congestion of spleen.
Chronic Effects: Chronic inhalation results in appetite loss, nausea, weight loss, insomnia, and unusual sensitivity (hyperesthesia) of the distal extremities followed by motor weakness, muscular degeneration, and diminished tendon reflexes and coordination. Repeated skin exposure can cause blistering, drying, and lesions.

FIRST AID

Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. For reddened or blistered skin, consult a physician. Wash affected area with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, *do not induce vomiting* due to aspiration hazard. Give conscious victim a mixture of 2 tablespoons of activated charcoal mixed in 8 oz of water to drink. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources, and provide maximum explosion-proof ventilation. Cleanup personnel should protect against vapor inhalation and liquid contact. Use nonsparking tools. Take up small spills with sand or other noncombustible adsorbent. Dike storage areas to control leaks and spills. Follow applicable OSHA regulations (29 CFR 1910.120).
Aquatic Toxicity: Bluegill, freshwater, LC$_{50}$, 8 ppm/96 hr.
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
RCRA Hazardous Waste (40 CFR 261.21): Characteristic of ignitability
CERCLA Hazardous Substance (40 CFR 302.4): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Since contact lens use in industry is controversial, establish your own policy.
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. There are no specific NIOSH recommendations. However, for vapor concentrations not immediately dangerous to life or health, use chemical cartridge respirator equipped with organic vapor cartridge(s), or a supplied-air respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Materials such as neoprene or polyvinyl alcohol provide excellent/good resistance for protective clothing. Note: Resistance of specific materials can vary from product to product.
Ventilation: Provide general and local explosion-proof exhaust ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed containers in a cool, dry, well-ventilated area away from heat and ignition sources and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IB liquid. Outside or detached storage preferred.
Engineering Controls: Avoid vapor inhalation and skin or eye contact. Consider a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Indoor use of this material requires explosion-proof exhaust ventilation to remove vapors. Only use gasoline as a fuel source due to its volatility and flammable/explosive nature. Practice good personal hygiene and housekeeping procedures. Wear clean work clothing daily.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Gasoline (*including casing-head and natural*)
DOT Hazard Class: Flammable liquid
ID No.: UN1203
DOT Label: Flammable liquid
DOT Packaging Exceptions: 173.118
DOT Packaging Requirements: 173.119

IMO Shipping Name: Gasoline
IMO Hazard Class: 3.1
ID No.: UN1203
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138, 140, 143, 146, 153, 159
Prepared by: M Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** W Silverman, MD; **Edited by:** JR Stuart, MS

DATE: 3 Dec 1990
HCSDS NO: 20058A

```
    /\
   /  \
  /    \
 /POISON\
 \ GAS  /
  \    /
   \  /
    \/
```

U.S. ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #s:
CRDEC Safety Office
301-671-4411 0700-1700
EST After normal duty
hours: 301-278-5201
Ask for CRDEC Staff
Duty Officer

D, AND THD (See Addendum A)

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

ANUFACTURER'S NAME: Department of the Army

FACTURER'S ADDRESS:
U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
CHEMICAL RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ATTN: SMCCR-CMS-E
ABERDEEN PROVING GROUND, MD 21010-5423

AS REGISTRY NUMBER: 505-60-2, 39472-40-7, 68157-62-0

HEMICAL NAME AND SYNONYMS:

Sulfide, bis (2-chloroethyl)
Bis(beta-chloroethyl)sulfide
Bis(2-chloroethyl)sulfide
1-chloro-2(beta-chloroethylthio)ethane
beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfide
beta, beta'-dichloroethyl sulfide
2,2'-dichloroethyl sulfide

ADE NAME AND SYNONYMS:

)
lfur mustard
rit
mpstoff "Lost"
rd Gas

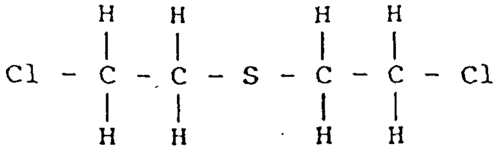
Senfgas
S-lost
Sulphur mustard gas
S-yperite
Yellow Cross Liquid
Yperite

H
HS

EMICAL FAMILY: chlorinated sulfur compound

RMULA/CHEMICAL STRUCTURE:

C4(H8)Cl2(S)



$ClCH_2CH_2SCH_2CH_2Cl$

FPA 704 SIGNAL: Health - 4
Flammability- 1
Reactivity- 1

```
      /\
     /  \
    /\1 /\
   /  \/  \
   \4 /\1 /
    \/  \/
     \  /
      \/
```

SECTION II - COMPOSITION

NGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
ulfur Mustard	C4(H8)Cl2(S)	100	0.003 mg/m3 (8 hr-TWA)

SECTION III - PHYSICAL DATA

OILING POINT DEG F (DEG C): 422 DEG F (217 DEG C)

APOR PRESSURE (mm Hg): 0.072 mm Hg @ 20 DEG C (0.11 mm Hg @ 25 DEG C)

APOR DENSITY (AIR=1): 5.5

OLUBILITY IN WATER: Negligible. Soluble in acetone, CH3(Cl), etrachloroethane, ethylbenzoate, and ether.

PECIFIC GRAVITY (H2O=1): 1.27 @ 20 DEG C

OLATILITY: 610 mg/m3 @ 20 DEG C
920 mg/m3 @ 25 DEG C

PPEARANCE AND ODOR: Water clear if pure. Normally pale yellow to black. Slight garlic type odor. The odor threshold for HD is 0.0006 mg/m3

SECTION IV - FIRE AND EXPLOSION DATA

LASHPOINT (METHOD USED): 105 DEG C (ignited by large explosive charges)

LAMMABILITY LIMITS (% by volume): Unknown

XTINGUISHING MEDIA: Water, fog, foam, CO2. Avoid use of extinguishing ethods that will splash or spread mustard.
PECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing he fire should be immediately evacuated from the area. Fires involving HD hould be contained to prevent contamination to uncontrolled areas. When esponding to a fire alarm in buildings or areas containing agents, fire-

ighting personnel should wear full firefighter protective clothing (without clothing) during chemical agent firefighting and fire rescue operations. spiratory protection is required. Positive pressure, full facepiece, IOSH-approved self-contained breathing apparatus (SCBA) will be worn where is danger of oxygen deficiency and when directed by the fire chief or hemical accident/incident (CAI) operations officer. The M9 or M17 series ask may be worn in lieu of SCBA when there is no danger of oxygen eficiency. In cases where firefighters are responding to a chemical accient/incident for rescue/reconnaissance purposes vice firefighting, they ill wear appropriate levels of protective clothing (see Section 8).

SECTION V - HEALTH HAZARD DATA

IRBORNE EXPOSURE LIMIT (AEL): The AEL for HD is 0.003 mg/m3 as proposed n the USAEHA Technical Guide No. 173, " Occupational Health Guidelines for he Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, nd HT". No individual should be intentionally exposed to any direct skin r eye contact.

FFECTS OF OVEREXPOSURE: HD is a vesicant (causing blisters) and alkylating gent producing cytotoxic action on the hematopoietic (blood-forming) issues which are especially sensitive. The rate of detoxification of HD in he body is very slow and repeated exposures produce a cumulative effect. D has been found to be a human carcinogen by the International Agency for esearch on Cancer (IARC).

an doses of HD in man are:

(skin) = 100 mg/kg
Ct50 (skin) = 2000 mg-min/m3 at 70 - 80 DEG F (humid environment)
= 1000 mg-min/m3 at 90 DEG F (dry environment)
Ct50 (eyes) = 200 mg-min/m3
Ct50 (inhalation) = 1500 mg-min/m3 (Ct unchanged with time)
D50 (oral) = 0.7 mg/kg

aximum safe Ct for skin and eyes are 5 and 2 mg-min/m3, respectively.

CUTE PHYSIOLOGICAL ACTION OF HD IS CLASSIFIED AS LOCAL AND SYSTEMIC.

OCALLY, HD affects both the eyes and the skin. SKIN damage occurs after ercutaneous resorption. Being lipid soluble, HD can be resorbed into all rgans. Skin penetration is rapid without skin irritation. Swelling blisters) and reddening (erythema) of the skin occurs after a latency eriod of 4-24 hours following the exposure, depending on degree of exposure nd individual sensitivity. The skin healing process is very slow. Tender kin, mucous membrane and perspiration covered skin are more sensitive to he effects of HD. HD's effect on the skin, however, is less than on the yes. Local action on the eyes produces severe necrotic damage and loss of yesight. Exposure of eyes to HD vapor or aerosol produces lacrimation, hotophobia, and inflammation of the conjunctiva and cornea.

YSTEMIC ACTIONS occur primarily through inhalation and ingestion. The HD r or aerosol is less toxic to the skin or eyes than the liquid form. inhaled, the upper respiratory tract (nose, throat, trachea) is amed after a few hours latency period, accompanied by sneezing, oughing, and bronchitis, loss of appetite, diarrhea, fever, and apathy. xposure to nearly lethal dose of HD can produce injury to bone marrow, ymph nodes, and spleen as indicated by a drop in WBC count and, therefore, esults in increased susceptibility to local and systemic infections. ngestion of HD will produce severe stomach pains, vomiting, and bloody tools after a 15-20 minute latency period.

HRONIC EXPOSURE to HD can cause sensitization, chronic lung impairment, cough, shortness of breath, chest pain), and cancer of the mouth, throat, espiratory tract, skin, and leukemia. It may also cause birth defects.

MERGENCY AND FIRST AID PROCEDURES:

NHALATION. Remove from the source IMMEDIATELY. If breathing has stopped, ive artificial respiration. If breathing is difficult, administer oxygen. eek medical attention IMMEDIATELY.

YE CONTACT. Speed in decontaminating the eyes is absolutely essential. emove person from the liquid source, flush the eyes immediately with water y tilting the head to the side, pulling the eyelids apart with the fingers nd pouring water slowly into the eyes. Do not cover eyes with bandages ut, if necessary, protect eyes by means of dark or opaque goggles. Transer the patient to a medical facility IMMEDIATELY.

KIN CONTACT. Don respiratory protective mask and gloves; remove victim rom agent source immediately. Flush skin and clothes with 5 percent soluion of sodium hypochlorite or liquid household bleach within one minute. ut and remove contaminated clothing, flush contaminated skin area again ith 5 percent sodium hypochlorite solution, then wash contaminated skin rea with soap and water. If shower facilities are available, wash horoughly and transfer to medical facility. If the skin becomes contamnated with a thickened agent, blot/wipe the material off immediately ith an absorbent pad/paper towel prior to using decontaminating solution.

NGESTION. Do not induce vomiting. Give victim milk to drink. Seek edical attention IMMEDIATELY.

SECTION VI - REACTIVITY DATA

TABILITY: Stable at ambient temperatures. Decomposition temperature is 49 DEG C to 177 DEG C. Mustard is a persistent agent depending on pH and oisture, and has been known to remain active for up to three years in soil.

NCOMPATIBILITY: Conditions to avoid. Rapidly corrosive to brass @ 65 DEG . Will corrode steel at a rate of .0001 in. of steel per month @ 65 DEG C.

AZARDOUS DECOMPOSITION: Mustard will hydrolyze to form HCl and hiodiglycol.

AZARDOUS POLYMERIZATION: Will not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

TEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Only personnel n full protective clothing (see Section 8) will be allowed in an area where ustard is spilled.

ECOMMENDED FIELD PROCEDURES:
he mustard should be contained using vermiculite, diatomaceous earth,

lay or fine sand and neutralized as soon as possible using copious amounts 5.25 percent Sodium Hypochlorite solution.

oop up all material and place in an approved DOT container. Cover the nts of the drum with decontaminating solution as above. The exterior he drum shall be decontaminated and then labeled IAW EPA and DOT egulations. All leaking containers shall be overpacked with vermiculite laced between the interior and exterior containers. Decontaminate and abel IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of the material used to decontaminate xterior of drum IAW Federal, state and local regulations. Conduct general rea monitoring with an approved monitor (see Section 8) to confirm that the tmospheric concentrations do not exceed the airborne exposure limit (see ections 2 and 8).

f 5.25 percent Sodium Hypochlorite solution is not available then the folowing decontaminants may be used instead and are listed in the order of reference: Calcium Hypochlorite, Decontamination Solution No. 2 (DS2), nd Super Tropical Bleach Slurry (STB). WARNING: Pure, undiluted Calcium ypochlorite (HTH) will burn on contact with liquid blister agent.

ECOMMENDED LABORATORY PROCEDURES:
minimum of 65 grams of decon solution per gram of HD is allowed to agitate or a minimum of one hour. Agitation is not necessary following the first our if a single phase is obtained. At the end of 24 hours, the resulting olution shall be adjusted to a pH between 10 and 11. Test for presence of ctive chlorine by use of acidic potassium iodide solution to give free odine color. Place 3 ml of the decontaminate in a test tube. Add several stals of Potassium Iodine and swirl to dissolve. Add 3 ml of 50 wt cent Sulfuric Acid:water and swirl. IMMEDIATE Iodine color indicates presence of active chlorine. If negative, add additional 5.25 percent um Hypochlorite solution to the decontamination solution, wait two ours, then test again for active chlorine. Continue procedure until positive chlorine is given by solution.

10 wt percent Calcium hypochlorite (HTH) mixture may be substituted for odium Hypochlorite. Use 65 grams of decon per gram of HD and continue the est as described for Sodium Hypochlorite.

coop up all material and place in approved DOT containers. Cover the contents of the drum with decontaminating solution as above. The exterior of he drum shall be decontaminated and then labeled IAW EPA and DOT regulaions. All leaking containers shall be overpacked with vermiculite placed etween the interior and exterior containers. Decontaminate and label IAW PA and DOT regulations. Dispose of the material IAW waste disposal methods rovided below. Dispose of the material used to decontaminate exterior of rum IAW Federal, state and local regulations. Conduct general area monitorng with an approved monitor (see Section 8) to confirm that the atmospheric oncentrations do not exceed the airborne exposure limits (see Section 8).

OTE: Surfaces contaminated with HD and then rinse-decontaminated may volve sufficient mustard vapor to produce a physiological response.

ASTE DISPOSAL METHOD: All decontaminated material should be collected, ontained and chemically decontaminated or thermally decomposed in an EPA oved incinerator, which will filter or scrub toxic by-products from uent air before discharge to the atmosphere. Any contaminated rotective clothing should be decontaminated using HTH or bleach and nalyzed to assure it is free of detectable contamination (3X) level. The lothing should then be sealed in plastic bags inside properly labeled drums nd held for shipment back to the DA issue point. Decontamination of waste r excess material shall be accomplished in accordance with the procedures utlined above with the following exception:

---- HD on laboratory glassware may be oxidized by its vigorous eaction with concentrated nitric acid.

pen pit burning or burying of HD or items containing or contaminated with D in any quantity is prohibited.

OTE: Some states define decontaminated surety material as a RCRA hazardous aste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

ESPIRATORY PROTECTION:

oncentration mg/m3	Respiratory Protection/Ensemble Required
ess than or equal to 0.003 as an 8-hr TWA	Protective mask not required provided that: (a) Continuous real-time monitoring (with alarm capability) is conducted in the work area at the 0.003 mg/m3 level of detection. (b) M9, M17 or M40 mask is available and donned if ceiling concentrations exceed 0.003 mg/m3. (c) Exposure has been limited to the extent practicable by engineering controls (remote operations, ventilation, and process isolation) or work practices. If these conditions are not met then the following applies: Full facepiece, chemical canister, air-purifying respirators. (The M9, M17, or M40 series or other certified equivalent masks are acceptable for this purpose in conjunction with the M3 toxicological agent protective (TAP) suit for dermal protection.)
eater than 003 as an hr TWA	The Demilitarization Protective Ensemble (DPE), 30 mil, may be used with prior approval from the AMC Field Safety Activity Use time for the 30 mil DPE must be restricted to two hours or less. NOTE: When 30 mil DPE is not available the M9 or M40 series mask with Level A protective ensemble including impregnated innerwear can be used. However, use time shall be restricted to the extent operationally feasible, and may not exceed one hour.

As an additional precaution, the cuffs of the sleeves and the legs of the M3 suit shall be taped to the gloves and boots respectively to reduce aspiration.

E..ILATION:

ocal Exhaust. Mandatory. Must be filtered or scrubbed.

pecial. Chemical laboratory hoods shall have an average inward face elocity of 100 linear feet per minute (lfpm) plus or minus 10% with the elocity at any point not deviating from the average face velocity by more hat 20%. Laboratory hoods shall be located such that cross drafts do not xceed 20% of the inward face velocity. A visual performance test utilizing moke producing devices shall be performed in assessing the ability of the ood to contain agent HD.

ther. Recirculation of exhaust air from agent areas is prohibited. No onnection between agent area and other areas through the ventilation system s permitted. Emergency backup power is necessary. Hoods should be tested emi-annually or after modification or maintenance operations. Operations hould be performed 20 cm inside hoods.

ROTECTIVE GLOVES: MANDATORY. Butyl toxicological agent protective gloves M3, M4, gloveset).

YE PROTECTION: As a minimum, chemical goggles will be worn. For splash azard use goggles and face-shield.

R PROTECTIVE EQUIPMENT: Full protective clothing will consist of the butyl rubber suit with hood, M2A1 boots, M3 gloves, impregnated nderwear, M9 series mask and coveralls (if desired), or the emilitarization Protective Ensemble (DPE). For general lab work, gloves nd lab coat shall be worn with M9 or M17 mask readily available.

n addition, when handling contaminated lab animals, a daily clean smock, oot covers, and head covers are required.

ONITORING: Available monitoring equipment for agent HD is the M8/M9 detecor paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monioring System (DAMMS), Automated Continuous Air Monitoring System (ACAMS), AM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), and the Miniaure Chemical Agent Monitor (MINICAM).

SECTION IX - SPECIAL PRECAUTIONS

RECAUTIONS TO BE TAKEN IN HANDLING AND STORING:
uring handling, the "buddy" (two-man) system will be used. Containers hould be periodically inspected for leaks, either visually or using a etector kit, and prior to transfering the containers from storage to work reas. Stringent control over all personnel handling HD must be exercised. hemical showers, eyewash stations, and personal cleanliness facilities must rovided. Each worker will wash their hands before meals and shower oughly with special attention given to hair, face, neck, and hands using nty of soap before leaving at the end of the work day. No smoking, ating, or drinking is permitted at the work site. Decontaminating equipent shall be conveniently located. Exits must be designed to permit rapid vacuation. HD should be stored in containers made of glass for Research,

evelopment, Test and Evaluation (RDTE) quantities or one-ton steel conainers for large quantities. Agent shall be double-contained in liquidight containers when in storage.

THER PRECAUTIONS: For additional information see AMC-R 385-131, "Safety egulations for Chemical Agents H, HD, HT, GB and VX" and USAEHA Technical uide No.173, "Occupational Health Guidelines for the Evaluation and Control f Occupational Exposure to Mustard Agents H, HD, and HT".

SECTION X - TRANSPORTATION DATA

ROPER SHIPPING NAME: Poisonous liquid, n.o.s.

OT HAZARD CLASS: Poison A

OT LABEL: Poison Gas

OT MARKING: Poisonous liquid, n.o.s. (Sulfide, bis 2-chloroethyl)) NA 1955

OT PLACARD: POISON GAS

MERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See Sections IV and VIII.

RECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be lacarded regardless of quantity. Driver shall be given full and complete nformation regarding shipment and conditions in case of emergency. AR 50-6 eals specifically with the shipment of chemical agents. Shipment of agents ill be escorted in accordance with AR 740-32.

---

hile the Chemical Research Development and Engineering Center, epartment of the Army believes that the data contained herein are actual and the opinions expressed are those of qualified experts egarding the results of the tests conducted, the data are not to be taken s a warranty or representation for which the Department of the Army or hemical Research Development and Engineering Center assumes legal esponsibility. They are offered solely for your consideration, nvestigation, and verification. Any use of these data and information must e determined by the user to be in accordance with applicable ederal, State, and local laws and regulations.

ADDENDUM A
ADDITIONAL INFORMATION FOR THICKENED HD

RADE NAME AND SYNONYMS: Thickened HD, THD

AZARDOUS INGREDIENTS: K125 (acryloid copolymer, 5%) is used to thicken D. K125 is not known to be hazardous except in a finely-divided, powder orm.

HYSICAL DATA: Essentially the same as HD except for viscosity. The iscosity of HV is between 1000 and 1200 centistokes @ 25 DEG C..

IRE AND EXPLOSION DATA: Same as HD.

TH HAZARD DATA: Same as HD except for skin contact. For skin contact, or respiratory protective mask and remove contaminated clothing IATELY. IMMEDIATELY scrape the HV form the skin surface, then wash the ontaminated surface with acetone. Seek medical attention IMMEDIATELY.

PILL, LEAK, AND DISPOSAL PROCEDURES: If spills or leaks of HV occur, ollow the same procedures as those for HD, but dissolve the THD in acetone rior to introducing any decontaminating solution. Containment of THD is enerally not necessary. Spilled THD can be carefully scraped off the ontaminated surface and placed in a fully removable head drum with a high ensity, polyethylene lining. The THD can then be decontaminated, after it as been dissolved in acetone, using the same procedures used for HD. ontaminated surfaces should be treated with acetone, then decontaminated sing the same procedures as those used for HD.

OTE: Surfaces contaminated with THD or HD and then rinse-decontaminated may volve sufficient mustard vapor to produce a physiological response.

PECIAL PROTECTION INFORMATION: Same as HD.

PECIAL PRECAUTIONS: Same as HD with the following addition. Handling the HD requires careful observation of the "stringers" (elastic, thread-like ttachments) formed when the agents are transferred or dispensed. These tringers must be broken cleanly before moving the contaminating device or ispensing device to another location, or unwanted contamination of a king surface will result.

SPORTATION DATA: Same as HD.

Material Safety Data Sheet

from Genium's Reference Collection

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 310
METHYLENE CHLORIDE
(Revision F)

Issued: September 1985
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION

27

Material Name: METHYLENE CHLORIDE

Description (Origin/Uses): Used widely in paint removers, as a solvent for plastics, as a degreasing agent, in propellant mixtures for aerosol sprays, and as a blowing agent in foams.

Other Designations: Dichloromethane; Freon 30®; Methane Dichloride; Methylene Bichloride; Methylene Dichloride; CH_2Cl_2; CAS No. 0075-09-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

1
2 0
-

HMIS			
H	2	R	1
F	1	I	3
R	0	S	3
PPG*		K	1

NFPA

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS/EXPOSURE LIMITS

Methylene Chloride, ca 100%

OSHA PEL	ACGIH TLV, 1988-89	Toxicity Data*
8-Hour TWA: 500 ppm	TLV-TWA: 50 ppm, 175 mg/m³	Rat, Oral, LD_{50}: 2136 mg/kg
Ceiling: 1000 ppm Acceptable Maximum Peak above the Ceiling: 2000 ppm for 5 Minutes in Any 2-Hour Period	(Adopted 1988-89)	Human, Inhalation, TC_{Lo}: 500 ppm (8 Hours)

*See NIOSH, *RTECS* (PA8050000), for additional data with references to irritative, reproductive, mutagenic, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 103.55°F (39.75°C) at 76 Torrs
Melting Point: -142°F (-96.7°C)
Vapor Density (Air = 1): 2.9
Vapor Pressure: 440 Torrs at 77°F (25°C)

Molecular Weight: 84.94 Grams/Mole
Solubility in Water (%): 1% by Weight
Specific Gravity (H_2O = 1): 1.3255 at 68°F (20°C)
% Volatile by Volume: Ca 100

Appearance and Odor: A clear, colorless, volatile liquid; distinctive, penetrating, ethereal odor. The odor will not serve as a useful warning property because concentrations of 100 ppm are not easily perceptible. Most persons can detect this odor at above 300 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature: 1033°F (556°C)	LEL: 12% v/v	UEL: 19% v/v

Extinguishing Media: *Methylene chloride is not flammable under ordinary conditions. However, flammable vapor-air mixtures can form at approximately 212°F (100°C). Use water spray to cool fire-exposed containers and to flush spills away from exposures. Use extinguishing agents that will put out the surrounding fire. **Unusual Fire or Explosion Hazards:** Methylene chloride vapor is heavier than air and may collect and concentrate in low-lying, confined spaces. The high vapor pressure of methylene chloride means that when it is spilled, its vapor concentration in air can increase rapidly. If this vapor is heated, an explosion hazard is associated with the vapor-air mixture. Containers of this material may rupture violently if they are involved in fires. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Methylene chloride is stable in closed containers during routine operations. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Methylene chloride can react dangerously with nitrogen tetroxide, liquid oxygen, potassium, sodium, sodium-potassium alloys, lithium, potassium hydroxide with N-methyl-N-nitroso urea, potassium *t*-butoxide, and finely powdered aluminum and magnesium. **Conditions to Avoid:** Avoid all exposure to sources of ignition, heat, and incompatible chemicals. Prolonged exposure to water may cause hydrolysis to highly corrosive hydrochloric acid when the temperature is above 140°F (60°C). In oxygen-enriched atmospheres or when heated (>212°F [100°C]), methylene chloride vapor can be readily ignited. **Hazardous Products of Decomposition:** Exposure to high temperature (from open flame, hot surfaces, uninsulated steam lines, welding arcs, etc.) can produce toxic and corrosive thermal-oxidative products of decomposition such as hydrogen chloride, carbon monoxide, and even small quantities of phosgene gas, which is extremely poisonous.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Methylene chloride is listed as a suspected human carcinogen by the ACGIH (which classifies it as a group A2 carcinogen). **Summary of Risks:** Accidental contact of liquid methylene chloride with skin or eyes causes painful irritation and possible burns if not promptly removed. Exposure by way of contaminated gloves, clothing, or paint remover formulations can produce these same irritant effects. Long-term exposure to mild or moderate doses of methylene chloride may cause a delayed (24 to 48 hours) onset of dizziness, headache, mental confusion, slurred speech, double vision, and sleeplessness. Medical recovery can be slow. Overexposure to methylene chloride can cause elevated levels of carboxy hemoglobin in the blood (this same effect results from overexposure to carbon monoxide). **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, CNS, liver, kidneys, and blood. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Headache, giddiness, stupor, irritability, fatigue, tingling in the limbs, and narcosis that is not usually fatal if the exposure is terminated before anesthetic death occurs. **Chronic Effects:** The ACGIH classification of this material as a suspected human carcinogen implies that cancer is a possible effect of chronic exposure to methylene chloride. **FIRST AID:** Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with

SECTION 6. HEALTH HAZARD INFORMATION, cont.

flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water and then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Note to Attending Physician:** Do not administer adrenalin. **Ingestion.** Unlikely. Should this type of exposure occur, do not induce vomiting because of the danger of aspiration. If spontaneous vomiting should occur, position the exposed person's head below his or her trunk to resist aspiration. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Absorbed methylene chloride is stored in body fat and metabolizes to carbon monoxide. This produced carbon monoxide increases and sustains carboxyhemoglobin levels in the blood, which concommitantly reduces the oxygen-carrying capacity of the blood. NIOSH advises preplacement and annual medical exams that emphasize liver, kidney, eye, skin, CNS, and respiratory system functions and a complete blood count. Simultaneous exposure to tobacco smoke, alcohol, and carbon monoxide, along with heavy manual labor, increases the body burden of a worker as well as the toxic hazards of the methylene chloride. In significant exposures, serum methylene chloride levels are of no clinical importance. Neurologic and hepatic status as well as carboxy hemoglobin should be monitored.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation. Cleanup personnel need protection against this liquid's contact with the skin or eyes as well as inhalation of its vapor. Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, NO. U080
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), § 307 (a), and the Resource Conservation and Recovery Act (RCRA), § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious neoprene, PVA, or Viton gloves, boots, aprons, and gauntlets, etc., to prevent any skin contact with liquid methylene chloride. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of acetone below the exposure limits cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. Floor or sump ventilation may be necessary. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Other:** Because the health effects of carbon monoxide and methylene chloride are additive (see sect. 6), workplaces should be equipped with automatic sensing equipment that identifies workroom atmospheric levels of both of these materials. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale methylene chloride vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store methylene chloride in closed, moisture-proof containers in a cool, dry, well-ventilated area away from sources of ignition, strong oxidizers, caustics, and incompatible chemicals (see sect. 5). Protect containers from physical damage.
Special Handling/Storage: Prevent moist air from entering storage containers. Provide ventilation at the floor level in storage areas because methylene chloride vapor is denser than air. Installation of a dryer and a safety seal on each tank is recommended. Aluminum is not recommended for use as a storage material; appropriate storage materials include galvanized iron, black iron, or steel. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Electrically ground and bond all containers and pipelines used in shipping, transferring, reacting, production, and sampling operations to prevent generating static sparks.

Transportation Data (49 CFR 172.101-2)
DOT Shipping Name: Dichloromethane *or* Methylene Chloride
DOT Hazard Class: ORM-A
ID No. UN1593
DOT Packaging Requirements: 49 CFR 173.605
DOT Packaging Exceptions: 49 CFR 173.505

IMO Shipping Name: Dichloromethane
IMO Hazard Class: 6.1
IMO Label: Saint Andrew's Cross (X)*
IMDG Packaging Group: III

*Harmful-Stow away from Foodstuffs.

References: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 683

Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

39

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kanеclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA
1
2 0
–

HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift

TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 °F (340-375 °C)
Melting Point: 42%: -2.2 °F (-19°C); 54%: 14 °F (-10 °C)
Vapor Pressure: 1 mm Hg at 100 °F (38 °C); 10^{-6} to 10^{-3} mm at 20 °C
Molecular Weight: 188.7 to 398.5
Specific Gravity: 1.3 to 1.8 at 20 °C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 °F (141-196 °C) OC*	**Autoignition Temperature:** 464 °F (240 °C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 °F (600-650 °C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) and NTP(169) list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.(103) **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
DOT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
Prepared by: MJ Wurth, BS; **Industrial Hygiene Review:** PA Roy MPH, CIH; **Medical Review:** AC Darlington, MD

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 677

1,1,2,2-TETRACHLOROETHANE

Issued: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name: 1,1,2,2-TETRACHLOROETHANE

Description (Origin/Uses): Used as a solvent primarily for cleaning and extraction procedures and as a chemical intermediate in the manufacture of trichloroethylene and tetrachloroethylene; and as an analytic reagent by textile manufacturers in polymer characterization tests.

Other Designations: Acetylene Tetrachloride; *sym*-Tetrachloroethane; $CHCl_2CHCl_2$; CAS No. 0079-34-5

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

0
2 0
–
Genium

HMIS			
H	2	R	1
F	0	I	4
R	0	S	–
PPG*		K	–

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
1,1,2,2-Tetrachloroethane, CAS No. 0079-34-5 *This material can be absorbed through intact skin, which contributes to overall exposure. **See NIOSH, *RTECS* (KI8575000), for additional data with references to reproductive, tumorigenic, and irritative effects.	Ca 100	**OSHA PEL (Skin*)** 8-Hr TWA: 1 ppm, 7 mg/m³ **ACGIH TLV (Skin*), 1988-89** TLV-TWA: 1 ppm, 7 mg/m³ **Toxicity Data**** Human, Oral, TD_{Lo}: 30 mg/kg Human, Inhalation, TC_{Lo}: 1000 mg/m³ (30 Mins) Rat, Oral, LD_{50}: 800 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 295°F (146°C)
Melting Point: -47°F (-44°C)
% Volatile by Volume: Ca 100
Vapor Pressure: 6 Torrs at 77°F (25°C)*
Molecular Weight: 168 Grams/Mole
Solubility in Water (%): Insoluble
Specific Gravity (H_2O = 1): 1.58658 at 77°F (25°C)

Appearance and Odor: A colorless, nonflammable, heavy, mobile liquid; sweetish, suffocating, characteristic chloroform odor. The odor recognition threshold is reported to be less than 3 ppm.

*At 77°F (25°C) the concentration of 1,1,2,2-tetrachloroethane in saturated air is approximately 7900 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature*	LEL*	UEL*

Extinguishing Media: *1,1,2,2-Tetrachloroethane does not burn. Use extinguishing agents that will put out the surrounding fire. **Unusual Fire or Explosion Hazards:** None reported. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode to protect against the effects of the nearby fire.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: 1,1,2,2-Tetrachloroethane is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hazardous reactions between 1,1,2,2-tetrachloroethane and 2,4-dinitrophenyl disulfide, nitrogen tetroxide, chemically active metals such as potassium; and strong caustics such as potassium hydroxide, sodium, sodium-potassium alloy, hot iron, aluminum, and zinc in the presence of steam are reported. **Conditions to Avoid:** Prevent exposure to the incompatible chemicals listed above. Contact with water causes appreciable hydrolysis that will degrade and decompose this liquid. **Hazardous Products of Decomposition:** Thermal-oxidative degradation of 1,1,2,2-tetrachloroethane can produce highly toxic gases such as carbon monoxide (CO) and oxides of chlorine (ClO_x).

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: NIOSH lists 1,1,2,2-tetrachloroethane as a carcinogen.
Summary of Risks: 1,1,2,2-Tetrachloroethane is absorbed through intact skin in significant amounts; one human fatality has been attributed to this route of exposure. This liquid is considered to be one of the most toxic of the common chlorinated hydrocarbons, particularly with respect to the liver. Severely acute exposure causes depression of the central nervous system (CNS), which can cause death within 12 hours. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, CNS, gastrointestinal system, liver, and kidneys. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** The initial symptoms of exposure are lacrimation, salivation, and irritation of the nose and throat; continued exposure can lead to nausea, vomiting, and narcosis. Also, low blood pressure and cardiac rhythm abnormalities; respiratory depression; nausea, vomiting, burns of the esophagus, and diarrhea; and anesthesia with dizziness leading to loss of consciousness and coma; plus possible transient liver and kidney changes.
Chronic Effects: The two sets of manifestations are (1) malaise, drowsiness, decreased appetite, then nausea and retching, a bad taste in the throat, constipation, headache, pale stools, jaundice, and dark urine, as well as mental confusion, stupor, and coma; and (2) hand

SECTION 6. HEALTH HAZARD INFORMATION, cont.

tremors, sensation of deafness, numbness in hands and feet, a decrease in reflexes, headache, and nausea. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected areas with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Keep the exposed person warm and at rest until medical help is available. **Ingestion.** Unlikely. Should this type of exposure occur, give the exposed person 3 glasses of water to drink and induce vomiting, then repeat this procedure. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Workers exposed to this liquid should be evaluated with a full battery of tests for the liver, kidneys, and CNS systems, as well as the blood.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, and provide adequate ventilation. Cleanup personnel must be properly clothed and equipped to protect the skin and eyes against any contact with the liquid as well as inhalation of its vapor (see sect. 8). Vacuum the spilled 1,1,2,2-tetrachloroethane and pump it into suitable containers for disposal. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Waste, No. U209
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a); and the Resource Conservation and Recovery Act (RCRA), § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of this liquid is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent skin contact with this liquid. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale 1,1,2,2-tetrachloroethane vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store 1,1,2,2-tetrachloroethane in closed, airtight containers in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5). **Special Handling/Storage:** Provide storage areas with adequate ventilation to prevent concentrations of the vapor from building up beyond the occupational exposure limits cited in section 2.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Tetrachloroethane
DOT Hazard Class: ORM-A
ID No. UN1702
DOT Packaging Requirements: 49 CFR 173.620
DOT Packaging Exceptions: 49 CFR 173.505

IMO Shipping Name: 1,1,2,2-Tetrachloroethane
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II

References: 1, 38, 84-94, 100, 116, 117, 120, 122.

Prepared by: PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

Genium Publishing Corporation
One Genium Plaza
Schenectady, NY 12304-4690 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 312
Trichloroethylene

Issued: 7/79 Revision: F, 9/92

Section 1. Material Identification

39

Trichloroethylene (C_2HCl_3) Description: Derived by treating tetrachloroethane with lime or other alkali in the presence of water, or by thermal decomposition of tetrachloroethane followed by steam distillation. Stabilizers such as epichlorohydrin, isobutanol, carbon tetrachloride, chloroform, benzene, or pentanol-2-triethanolamine are then added. Used as a degreasing solvent in electronics and dry cleaning, a chemical intermediate, a refrigerant and heat-exchange liquid, and a diluent in paint and adhesives; in oil, fat, and wax extraction and in aerospace operations (flushing liquid oxygen). Formerly used as a fumigant (food) and anesthetic (replaced due to its hazardous decomposition in closed-circuit apparatus).
Other Designations: CAS No. 79-01-6; acetylene trichloride; Algylen; Anamenth; Benzinol; Cecolene; Chlorylen; Dow-Tri; ethylene trichloride; Germalgene; Narcogen; Triasol; trichloroethene; TCE; 1,1,3-trichloroethylene.
Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

Cautions: TCE is irritating and toxic to the central nervous system (CNS). Inhalation of high concentrations have lead to death due to ventricular fibrillation. Chronic exposure may lead to heart, liver, and kidney damage. The liquid is absorbed through the skin. Although it has a relatively low flash point, TCE burns with difficulty.

R 1
I 2
S 2*
K 3
* Skin absorption

NFPA
2
2 0
-

HMIS
H 2†
F 2
R 0
PPE‡
† Chronic Effects
‡ Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Trichloroethylene, < 100% [contains stabilizers (Sec. 1)].

1991 OSHA PELs
8-hr TWA: 50 ppm (270 mg/m³)
15-min STEL: 200 ppm (1080 mg/m³)

1990 IDLH Level
1000 ppm

1990 NIOSH REL
10-hr TWA: 25 ppm (~135 mg/m³)

1992-93 ACGIH TLVs
TWA: 50 ppm (269 mg/m³)
STEL: 200 ppm (1070 mg/m³)

1990 DFG (Germany) MAK
Ceiling: 50 ppm (270 mg/m³)
Category II: Substances with systemic effects
Half-life: 2 hr to shift length
Peak Exposure Limit: 250 ppm, 30 min average value; 2 peaks/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 160 ppm/83 min caused hallucinations and distorted perceptions.
Human, lymphocyte: 5 mL/L caused DNA inhibition.
Rabbit, skin: 500 mg/24 hr caused severe irritation.
Rabbit, eye: 20 mg/24 hr caused moderate irritation.
Mouse, oral, TD_{Lo}: 455 mg/kg administered intermittently for 78 weeks produced liver tumors.

* See NIOSH, *RTECS* (KX4550000), for additional irritation, mutation, reproductive, tumorigenic and toxicity data.

Section 3. Physical Data

Boiling Point: 189 °F (87 °C)
Freezing Point: -121 °F (-85 °C)
Viscosity: 0.0055 Poise at 77 °F (25 °C)
Molecular Weight: 131.38
Density: 1.4649 at 20/4 °C
Refraction Index: 1.477 at 68 °F (20 °C/D)
Odor Threshold: 82 to 108 ppm (*not an effective warning*)

Vapor Pressure: 58 mm Hg at 68 °F (20 °C); 100 mm Hg at 32 °F (0 °C)
Saturated Vapor Density (Air = 0.075 lbs/ft³; 1.2 kg/m³): 0.0956 lbs/ft³; 1.53 kg/m³
Water Solubility: Very slightly soluble; 0.1% at 77 °F (25 °C)
Other Solubilities: Highly soluble in organic solvents (alcohol, acetone, ether, carbon tetrachloride, & chloroform) and lipids.
Surface Tension: 29.3 dyne/cm

Appearance and Odor: Clear, colorless (sometimes dyed blue), mobile liquid with a sweet chloroform odor.

Section 4. Fire and Explosion Data

Flash Point: 90 °F (32 °C) CC	**Autoignition Temperature:** 788 °F (420 °C)	**LEL:** 8% (25 °C); 12.5% (100 °C)	**UEL:** 10% (25 °C); 90% (100 °C)

Extinguishing Media: A Class 1C Flammable Liquid. Although it has a flash point of 90 °F, TCE burns with difficulty. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapor/air mixtures may explode when ignited. Container may explode in heat of fire. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection against TCE. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: TCE slowly decomposes in the presence of light and moisture to form corrosive hydrochloric acid. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include alkalis (sodium hydroxide), chemically active metals (aluminum, beryllium, lithium, magnesium, sodium, potassium, and titanium), epoxides, and oxidants (nitrogen tetraoxide, perchloric acid). Contact with 1-chloro-2,3-epoxy propane or the mono and di 2,3-epoxypropyl ethers of 1,4-butanediol + 2,2-bis-4(2',3'-epoxypropoxy)-phenylpropane can, in the presence of catalytic quantities of halide ions, cause dehydrochlorination of TCE to explosive dichloroacetylene. **Conditions to Avoid:** Exposure to light, moisture, ignition sources, and incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of TCE (above 300 °C) or exposure to ultraviolet light can produce carbon dioxide (CO_2) and toxic dichloro acetylene (explosive), chlorine, hydrogen chloride, and phosgene gas.

Section 6. Health Hazard Data

Carcinogenicity: The following agencies have rated TCE's carcinogenicity: IARC (Class 3, limited animal evidence & insufficient human data), Germany MAK (Class B, justifiably suspected of having carcinogenic potential), & NIOSH (Class X, carcinogen defined with no further categorization). **Summary of Risks:** TCE vapor is irritating to the eyes, nose, and respiratory tract and inhalation of high concentrations can lead to severe CNS effects such as unconsciousness, ventricular arrythmias, and death due to cardiac arrest. Mild liver dysfunction was also seen at levels high enough to produce CNS effects. Contact with the liquid is irritating to the skin and can lead to dermatitis by defatting the skin. Chronic toxicity is observed in the victims increasing intolerance to alcohol characterized by 'degreasers flush', a transient redness of the face, trunk, and arms. The euphoric effect of TCE has led to craving, and habitual sniffing of its vapors.

Continue on next page

Section 6. Health Hazard Data, *Continued*

TCE crosses the placental barrier and thus exposes the fetus (any effects are yet unknown). There are increased reports of menstrual disorders in women workers and decreased libido in males at exposures high enough to cause CNS effects. TCE is eliminated unchanged in expired air and as metabolites (trichloroacetic acid & trichloroethanol) in blood and urine. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the nervous system, skin, heart, liver, and kidney. **Target Organs:** Respiratory, central & peripheral nervous, and cardiovascular (heart) systems, liver, kidney, and skin. **Primary Entry Routes:** Inhalation, skin and eye contact, and ingestion (rarely). **Acute Effects:** Vapor inhalation can cause eye, nose, and throat irritation, nausea, blurred vision, overexcitement, headache, drunkenness, memory loss, irregular heartbeat (resulting in sudden death), unconsciousness, and death due to cardiac failure. Skin contact with the liquid can cause dryness and cracking and prolonged exposure (generally if the victim is unconscious) can cause blistering. Eye contact can cause irritation and watering, with corneal epithelium injury in some cases. Ingestion of the liquid can cause lip, mouth, and gastrointestinal irritation, irregular heartbeat, nausea and vomiting, diarrhea (possibly blood-stained), drowsiness, and risk of pulmonary edema (fluid in lungs). **Chronic Effects:** Effects may persist for several weeks or months after repeated exposure. Symptoms include giddiness, irritability, headache, digestive disturbances, mental confusion, intolerance to alcohol (degreasers flush), altered color perception, loss or impairment of sense of smell, double vision, and peripheral nervous system function impairment including persistent neuritis, temporary loss of sense of touch, and paralysis of the fingers from direct contact with TCE liquid.

FIRST AID Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. Do not give milk, as its fat content (TCE is lipid soluble) may inhance gastrointestinal absorption of TCE. **Note to Physicians:** TCE elimination seems to be triphasic with half lives at 20 min, 3 hr, and 30 hr. Some success is seen in treating patients with propranolol, atropine, and disulfiram. Monitor urine and blood (lethal level = 3 to 110 μg/mL) metabolites. BEI = 100 mg/g creatinine (trichloroacetic acid) in urine, *sample at end of workweek.* BEI = 4 mg/L (trichloroethanol) in blood, *sample at end of shift at end of the workweek.* These tests are not 100% accurate indicators of exposure; monitor TCE in expired air as a confirmatory test.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all ignition sources. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable container for later disposal. For large spills, flush to containment area where density stratification will form a bottom TCE layer which can be pumped and containerized. Report any release in excess of 1000 lbs. Follow applicable OSHA regulations (29 CFR 1910.120). **Ecotoxicity Values:** Bluegill sunfish, LC_{50} = 44,700 μg/L/96 hr; fathead minnow (*Pimephales promelas*), LC_{50} = 40.7 mg/L/96 hr. **Environmental Degradation:** In air, TCE is photooxidized with a half-life of 5 days and reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water it evaporates rapidly in minutes to hours. TCE rapidly evaporates and may leach since it does not absorb to sediment. **Soil Absorption/Mobility:** TCE has a Log K_{oc} of 2, indicating high soil mobility. **Disposal:** Waste TCE can be poured on dry sand and allowed to vaporize in isolated location, purified by distillation, or returned to supplier. A potential candidate for rotary kiln incineration at 1508 to 2912 °F (820 to 1600 °C) with an acid scrubber to remove halo acids. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a RCRA Hazardous Waste (40 CFR 261.33 & 261.31): No. U228 & F002 (*spent solvent*)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001, CWA Sec. 311 (b)(4), & CWA Sec. 307 (a)]

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear chemical safety goggles (cup-type or rubber framed, equipped with impact-resistant glass), per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. At any detectable concentration, wear a SCBA with a full facepiece operated in pressure demand or other positive pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made from Viton or Neoprene to prevent skin contact. *Do not* use natural rubber or polyvinyl chloride (PVC). **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in steel drums, in a cool, dry, well-ventilated area away from sunlight, heat, ignition sources, and incompatibles (Sec. 5). Store large quantities in galvanized iron, black iron, or steel containers; small amounts in dark (amber) colored glass bottles. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Design processes so that the operator is not directly exposed to the solvent or its vapor. Do not use open electric heaters, high-temperature processes, arc-welding or open flames in TCE atmospheres. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers with emphasis on skin, respiratory, cardiac, central and peripheral nervous systems, and liver and kidney function. Employ air and biological monitoring (BEIs). Instruct employees on safe handling of TCE.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Trichloroethylene
DOT Hazard Class: 6.1
ID No.: UN1710
DOT Packing Group: III
DOT Label: Keep Away From Food
DOT Special Provisions (172.102): N36, T1

Packaging Authorizations
a) Exceptions: 173.153
b) Non-bulk Packaging: 173.203
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 60L
b) Cargo Aircraft Only: 220L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 40

MSDS Collection References: 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 136, 139, 140, 148, 149, 153, 159, 163, 164, 167, 168, 171, 174, 175, 176, 180.

Prepared by: M Gannon, BA; **Industrial Hygiene Review:** D Wilson, CIH; **Medical Review:** AC Darlington, MD

Attachment C
Emergency Procedures for Exposure to Hazardous Materials/Waste

ATTACHMENT C

EMERGENCY PROCEDURES FOR EXPOSURE TO HAZARDOUS MATERIALS/WASTE

1. Call ambulance or transport individual to hospital/clinic immediately. Don't forget to take the HASP with you; it contains information on the contaminants expected to be found on site and will assist the physician in his/her assessment of the exposure.

2. Fill in Potential Exposure Report, answering each of the questions to the best of your ability.

3. Contact our physician(s) at EMR as soon as possible. The procedure is as follows:

    a. **Call EMR at 1-800-229-3674!**

    b. Ask to speak with:

        Dr. David L. Barnes;
        Dr. Elaine Theriault; or
        Ms. T.J. Wolff, R.N.

Note: During nonbusiness hours (after 6 p.m.) call 1-800-229-3674 and follow directions for paging the aforementioned individuals.

4. Once in contact with any of these individuals, explain what has happened (they will review the information on the form with you and may ask you to fax the form to them, if possible), and allow either of them to speak with the attending physician.

5. When asked about payment (and they will ask), inform the Hospital/Clinic/Physician that this is a "work related injury" and have them contact the Benefits Coordinator at (412) 269-2744. Have invoices sent to:

    Michael Baker Jr. Inc.
    Attn: Benefits Coordinator
    Airport Office Park, Bldg. 3
    Coraopolis, PA 15108

6. Contact the Project Manager and the Project Health and Safety Officer as soon as it is feasible, but wait no longer than 24 hours.

Baker
Baker Environmental, Inc

POTENTIAL EXPOSURE REPORT

Name: ______________________ Date of Exposure: ______________

Social Security No.: ______________ Age: ________ Sex: ________

I. Exposing Agent

Name of Product or Chemicals (if known) ______________________

____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? ______________________

How long did individual work in area before signs/symptoms developed?

____

Was protective gear being used? If yes, what was the PPE?

____

Was there skin contact? ______________________

Was the exposing agent inhaled? ______________________

Were other persons exposed? If yes, did they experience symptoms?

____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately with Exposure:

☐ Burning of eyes, nose, or throat
☐ Tearing
☐ Headache
☐ Cough
☐ Shortness of breath
☐ Delirium
☐ Chest tightness/pressure
☐ Nausea/vomiting
☐ Dizziness
☐ Weakness
☐ Heat flashes
☐ Other ______________

Delayed Symptoms:

☐ Weakness
☐ Nausea/vomiting
☐ Shortness of breath
☐ Cough
☐ Loss of appetite
☐ Abdominal pain
☐ Headache
☐ Numbness/tingling
☐ Other ______________

POTENTIAL EXPOSURE REPORT

IV. Present Status of Symptoms (check off appropriate symptoms)

☐ Burning of eyes, nose, or throat
☐ Tearing
☐ Headache
☐ Cough
☐ Shortness of breath
☐ Chest tightness/pressure
☐ Cyanosis (bluish skin color)
☐ Nausea/vomiting
☐ Dizziness
☐ Weakness
☐ Loss of appetite
☐ Abdominal pain
☐ Numbness/tingling
☐ Other ____________________

Have symptoms (please check off appropriate response and give duration of symptoms):

Improved ________ Worsened ________ Remain Unchanged _______

V. Treatment of Symptoms (check off appropriate response)

None _________ Self-medicated ________ Physician treated ________

VI. Name ______________________________
(Attending physician)

VII. Hospital/Clinic ______________________________

Source: EMR, Inc.